

**STUDY GUIDE**

Frommer  
Stabulas-Savage

# RADIOLOGY

FOR THE

# DENTAL PROFESSIONAL



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Study Guide for

**RADIOLOGY** for the  
*Dental Professional*

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Study Guide for

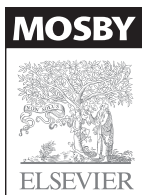
# **RADIOLOGY** for the *Dental Professional*

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# Preface

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This study guide is intended to accompany the ninth edition of the textbook *Radiology for the Dental Professional*. The ninth edition of this study guide includes additional questions not included in the previous editions.

Each chapter in the study guide relates to a corresponding chapter in the textbook and stresses the essential information of the chapter through the use of definitions, short essays (comprehension), matching questions, illustrations, completion, and multiple choice questions. The answers for the matching, illustrations, completion, and multiple choice questions are available in the instructor's section of the Evolve resource site.

Educational objectives are included at the beginning of each chapter to help the students focus on the material and concepts they are expected to learn and how this information is to be applied in the dental clinical setting.

The following suggestions will help students use this study guide to identify strengths and weaknesses.

1. Review the contents of each chapter before you attempt to do the exercise. Do not treat the questions individually and then refer to the text for the correct answer. Deal with the chapter's subject matter as a whole, since many of the questions are interrelated. This is a learning exercise meant to help you learn the material presented in the textbook, not an examination for grades.
2. Remember that the same subject matter may be repeated in different question forms in each chapter or other chapters, since the material overlaps. The subjects of the questions are not in the same order as they appear in the textbook, so don't expect to find a question in order for every page.
3. Read each question and study each illustration carefully before answering. You may know the answer or you may arrive at the correct answer by knowing which answers are incorrect.

This study guide is designed so that the pages can be easily removed, submitted if required, and placed in the student's notebook with the corresponding lecture notes.

**Herbert H. Frommer**  
**Jeanine J. Stabulas-Savage**

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# Ionizing Radiation and Basic Principles of X-Ray Generation

## Educational Objectives

*After reading Chapter 1 of the textbook and completing this exercise, the student will*

1. Understand the nature and production of ionizing radiation and the history of x-rays.
2. Understand the generation of x-rays in the dental x-ray tube.
3. Be able to apply these concepts and principles to clinical radiography.

## I. Definitions

Define/explain the following terms.

1. Atom \_\_\_\_\_  
\_\_\_\_\_
2. Binding energy \_\_\_\_\_  
\_\_\_\_\_
3. Bremsstrahlung \_\_\_\_\_  
\_\_\_\_\_
4. Electromagnetic spectrum \_\_\_\_\_  
\_\_\_\_\_
5. Energy wave \_\_\_\_\_  
\_\_\_\_\_
6. Frequency \_\_\_\_\_  
\_\_\_\_\_
7. Hittoft-Crookes tube \_\_\_\_\_  
\_\_\_\_\_
8. Ionization \_\_\_\_\_  
\_\_\_\_\_
9. Isotope \_\_\_\_\_  
\_\_\_\_\_

10. Photon energy \_\_\_\_\_  
\_\_\_\_\_
11. Radiation \_\_\_\_\_  
\_\_\_\_\_
12. Radioactive \_\_\_\_\_  
\_\_\_\_\_
13. Thermionic emission effect \_\_\_\_\_  
\_\_\_\_\_
14. Wavelength \_\_\_\_\_  
\_\_\_\_\_
15. X-rays \_\_\_\_\_  
\_\_\_\_\_

## II. Comprehension Exercise

1. Explain the differences and similarities between radio waves and x-rays and their significance in dental radiology.
2. Explain why the dental x-ray machine is said to be “inefficient” in the production of x-radiation.
3. What is the source of the heat produced in the dental x-ray tube?

4. Explain the difference between duty rating and duty cycle.
5. Compare the binding energy of the various shells of an atom.
6. Clarify the difference between characteristic x-rays and Bremsstrahlung x-rays.
7. Explain the function of the molybdenum focusing cup.
8. What accounts for ionizing radiation's potential to cause harmful biologic effects? Explain.
9. Cite the reasons for using tungsten as the material for the target in the dental x-ray tube.
10. Explain the difference between the filament and the high-tension circuit in the dental x-ray tube.

11. Describe the difference between the on/off switch and the exposure switch.
12. Compare the source of electrons in the original x-ray tubes with today's tubes.
13. List at least five properties of x-radiation as evidenced in dental radiographic procedures.
14. State the significance of the high-tension circuit in the production of x-rays in dentistry.
15. What is the relationship between the "wavelength" of a specific radiation and its ability to penetrate opaque structures?

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

#### Column A

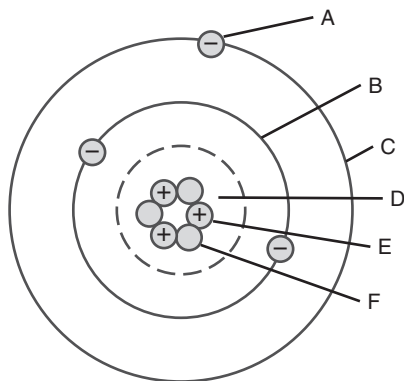
- \_\_\_\_\_ 1. electrons
- \_\_\_\_\_ 2. binding energy
- \_\_\_\_\_ 3. focal spot
- \_\_\_\_\_ 4. particulate radiation
- \_\_\_\_\_ 5. Crookes tube
- \_\_\_\_\_ 6. unit of x-ray exposure
- \_\_\_\_\_ 7. 70kVp or above
- \_\_\_\_\_ 8. protons
- \_\_\_\_\_ 9. short wavelengths
- \_\_\_\_\_ 10. ionization
- \_\_\_\_\_ 11. focusing cup
- \_\_\_\_\_ 12. unstable isotopes
- \_\_\_\_\_ 13. thermionic emission effect
- \_\_\_\_\_ 14. shells
- \_\_\_\_\_ 15. atomic mass

#### Column B

- a. fixed orbits
- b. cathode
- c. gamma rays
- d. number of protons
- e. electron cloud
- f. anode
- g. tungsten filament
- h. negative charge
- i. number of neutrons
- j. beta particles
- k. characteristic x-rays
- l. positive charge
- m. x-rays
- n. K shell
- o. Roentgen
- p. roentgen
- q. loss of an electron

### IV. Illustrations

1. (Figure 1-1) Label the components in this diagram of an atom.



a.

b.

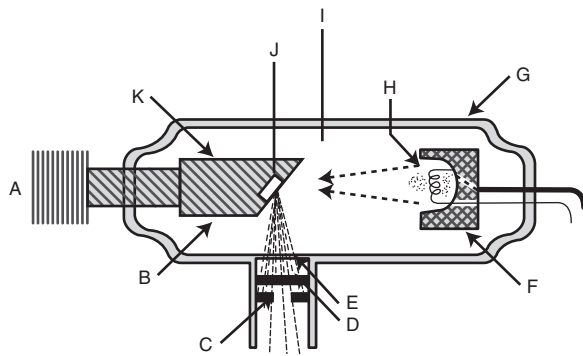
c.

d.

e.

f.

2. (Figure 1-2) Identify the lettered components in this diagram of the dental x-ray tube and list the function of each.



Component

Function

a.

b.

c.

d.

e.

f.

g.

h.

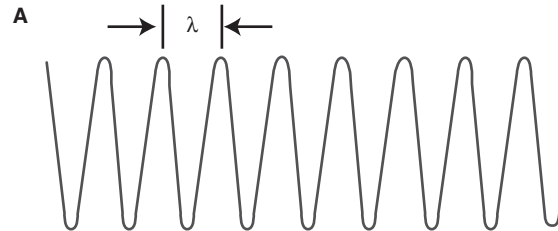
i.

j.

k.

3. Provide a schematic drawing of the composition of matter.

4. (Figure 1-3) In this schematic drawing of dental x-rays, which x-ray, A or B:



- a. has the longest wavelength? \_\_\_\_\_  
 b. has the most energy? \_\_\_\_\_  
 c. has the higher frequency? \_\_\_\_\_  
 d. would be more penetrating? \_\_\_\_\_

5. Draw a diagram of the Bremsstrahlung reaction at the tungsten target.



## V. Complete These Statements

1. An example of particulate radiation is \_\_\_\_\_,  
\_\_\_\_\_,  
\_\_\_\_\_, or  
\_\_\_\_\_.
2. The effect of electromagnetic radiation on living organisms varies depending on the \_\_\_\_\_.
3. The amount of energy contained in electromagnetic radiation is determined by their \_\_\_\_\_ and \_\_\_\_\_.
4. Electric current within the dental x-ray tube flows from a \_\_\_\_\_ pole to a \_\_\_\_\_ pole.
5. Patients undergoing cancer therapy may receive radiation treatment from \_\_\_\_\_.
6. When atoms have the same atomic number but different atomic mass numbers, they are called \_\_\_\_\_.
7. A \_\_\_\_\_ is the smallest particle of a substance that retains the properties of the substance.
8. Individual units of radiation energy are referred to as \_\_\_\_\_.
9. In the dental x-ray machine the amount of energy produced at the anode as heat is \_\_\_\_\_%.
10. X-rays can affect a photographic emulsion that, when processed, produces \_\_\_\_\_.
11. The \_\_\_\_\_ refers to the number of consecutive seconds a machine can be operated before overheating.
12. Particulate radiations most commonly are emitted from radioactive substances called \_\_\_\_\_.
13. Two examples of electromagnetic radiation are \_\_\_\_\_ and \_\_\_\_\_.
14. The three basic elements of an x-ray tube needed to produce x-rays are:  
(1) \_\_\_\_\_,  
(2) \_\_\_\_\_, and  
(3) \_\_\_\_\_.
15. The milliamperage dial controls the \_\_\_\_\_ of electrons that "boil off" the tungsten filament.

## VI. Multiple Choice

Select the best answer.

1. Which of the following occurs at 70kVp or higher and accounts for a very small part of the x-rays produced in the dental x-ray machine?
  - a. Bremsstrahlung radiation
  - b. Compton scatter
  - c. characteristic radiation
  - d. coherent scatter
  - e. photoelectron interaction
2. Which of the following delineates where the thermionic emission effect takes place?
  - a. tungsten target
  - b. focal area
  - c. tungsten filament of the anode
  - d. tungsten filament at the cathode
  - e. step-down transformer

3. The person accredited with the initial discovery of x-rays is
  - a. Dr. Otto Walkhoff
  - b. William D. Coolidge
  - c. Wilhelm Conrad Roentgen
  - d. Thomas Alva Edison
  - e. Dr. C. Edmond Kells
4. You turn on the dental x-ray machine in the morning for your first patient. In doing so, you
  - a. activate the high-tension circuit
  - b. heat the anode
  - c. activate the filament circuit
  - d. turn on the step-up transformer
  - e. produce x-rays
5. Which of the following electrons has the greatest binding energy?
  - a. N shell electrons
  - b. M shell electrons
  - c. L shell electrons
  - d. K shell electrons
  - e. None of the above
6. X-rays are generated when a stream of electrons traveling from one side of a vacuum tube is stopped suddenly by its impact on the
  - a. filament cup
  - b. tungsten target of the anode
  - c. tungsten target of the cathode
  - d. focusing cup
  - e. copper stem
7. Which of the following does not occur when the high voltage circuit is activated?
  - a. The x-ray machine produces an audible and visible signal.
  - b. Electrons travel from the filament to the target.
  - c. Heat is produced.
  - d. Electrons produced at the cathode fire across the tube and hit the target.
  - e. X-rays are produced at the filament.
8. All of the following are examples of electromagnetic radiation *except*
  - a. x-rays
  - b. beta rays
  - c. gamma rays
  - d. microwaves
  - e. light waves
9. Which of the following statements are *not* true concerning radioactive substances?
  - a. They are utilized in cancer therapy.
  - b. They are unstable elements.
  - c. They produce high-energy waves.
  - d. They are utilized to produce an image in dental radiography.
  - e. All of the above are true.
10. Which of the following is incorrect?
  - a. X-rays have no charge.
  - b. X-rays have no weight.
  - c. X-rays travel at the speed of sound.
  - d. X-rays have short wavelengths.
  - e. X-rays cause ionization in tissues.
11. The dental x-ray tube is said to be "inefficient" because
  - a. energy flows from the negative to the positive pole
  - b. 1% of the energy produced is x-radiation
  - c. the radiation produced is x-radiation
  - d. it has a duty rating and a duty cycle
  - e. it can overheat if used too frequently
12. As a result of the multiple Bremsstrahlung reactions,
  - a. a heterogeneous x-ray spectrum is produced
  - b. the succeeding x-rays produced will have less energy
  - c. the later x-rays produced have less penetrating ability
  - d. the wavelengths are different
  - e. All of the above are valid statements.

13. Which of the following has the ability to affect living organisms?
- supervoltage x-rays
  - microwaves
  - magnetic resonance imaging
  - electric waves
  - ultrasonic waves
14. To prevent the x-ray tube and its components from overheating,
- each machine has a duty cycle and a duty rating
  - the milliamperage setting should not exceed 15
  - rotating anodes are utilized in extraoral radiography
  - the copper sleeve surrounds the target
  - All of the above are true.
15. The radiation produced at the atomic level in dental radiography is predominantly as a result of
- characteristic radiation
  - radioactivity
  - gamma rays
  - Bremsstrahlung
  - total energy loss

## VII. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

- The focusing cup is found at the cathode. **T/F**
- Bremsstrahlung radiation is the main source of radiation in the dental tube. **T/F**
- X-rays are weightless. **T/F**
- Ten percent of all reactions in the tube produce heat. **T/F**
- X-rays are a type of ionizing radiation. **T/F**

# The Dental X-Ray Machine

## Educational Objectives

*After reading Chapter 2 of the textbook and completing this exercise, the student will*

1. Understand the function of the dental x-ray machine.
2. Understand the function of the settings in the dental x-ray unit, the variables of the control panel, and the properties of the x-ray beam.
3. Be able to apply these concepts and principles to clinical radiography.

## I. Definitions

Define/explain the following terms.

1. Alternating current \_\_\_\_\_  
\_\_\_\_\_
2. Central ray \_\_\_\_\_  
\_\_\_\_\_
3. Collimation \_\_\_\_\_  
\_\_\_\_\_
4. Direct current \_\_\_\_\_  
\_\_\_\_\_
5. Electric current \_\_\_\_\_  
\_\_\_\_\_
6. Filtration \_\_\_\_\_  
\_\_\_\_\_
7. Half-value layer (HVL) \_\_\_\_\_  
\_\_\_\_\_
8. Inherent filtration \_\_\_\_\_  
\_\_\_\_\_
9. Rectangular collimation \_\_\_\_\_  
\_\_\_\_\_

10. Rectification \_\_\_\_\_  
\_\_\_\_\_
11. Scatter radiation \_\_\_\_\_  
\_\_\_\_\_
12. Transformer \_\_\_\_\_  
\_\_\_\_\_
13. Total filtration \_\_\_\_\_  
\_\_\_\_\_
14. Useful beam \_\_\_\_\_  
\_\_\_\_\_
15. Voltage \_\_\_\_\_  
\_\_\_\_\_

## II. Comprehension Exercise

1. Explain the difference between filtration and collimation of the x-ray beam. What are the clinical consequences of each?
  
  
  
  
  
  
  
  
  
  
2. Explain the difference between milliamperage and kilovoltage in the dental x-ray machine. What is the clinical significance of each?
  
  
  
  
  
  
  
  
  
  
3. Explain the concept of milliampere seconds (mAs).

4. Explain why exposure times are best expressed in impulses rather than in fractions of seconds.
5. What is rectangular collimation? Why is it important?
6. Do all x-ray photons at the anode of the x-ray tube have the same energy? Why? If not, what is done to correct this situation?
7. Explain why the use of an alternating current produces a heterogeneous x-ray beam.
8. What is the ideal size and shape of an intraoral x-ray beam?
9. What are the types of transformers used in the dental x-ray machine, and what is their function?

10. Why are electronic timers recommended for contemporary use as opposed to the utilization of the old mechanical timers?
11. What factors determine the intensity of the x-ray beam? Explain your answer.
12. Why is the half-value layer a more appropriate means of describing beam quality and penetration than kilovoltage?
13. What factors are used to determine the milliamperere seconds required at a given kilovoltage? What is the clinical significance of using a higher milliamperage and a shorter exposure time?
14. What are the federal regulation specifications regarding total filtration of the x-ray beam at various kilovoltage settings?
15. Why would a change to rectangular collimation increase the incidence of collimator cutoff? How could this change be achieved without evidence of an increase in this exposure error?

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

#### Column A

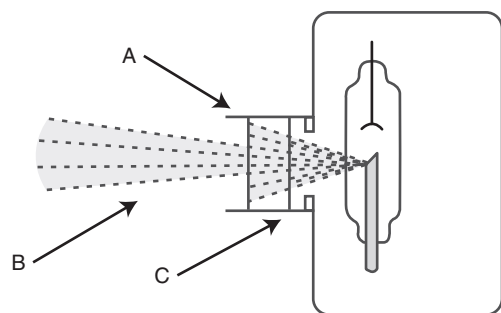
- \_\_\_\_\_ 1. lead diaphragm
- \_\_\_\_\_ 2. impulse
- \_\_\_\_\_ 3. filtration
- \_\_\_\_\_ 4. ampere
- \_\_\_\_\_ 5. useful beam
- \_\_\_\_\_ 6. rectangular collimation
- \_\_\_\_\_ 7. electricity
- \_\_\_\_\_ 8. quantity of x-rays
- \_\_\_\_\_ 9. cycle
- \_\_\_\_\_ 10. pointed cone
- \_\_\_\_\_ 11. position-indicating device (PID)
- \_\_\_\_\_ 12. rectification
- \_\_\_\_\_ 13. half-value layer (HVL)
- \_\_\_\_\_ 14. mechanical timers
- \_\_\_\_\_ 15. quality of x-rays

#### Column B

- a. removes long wavelengths
- b. collimating device
- c. x-ray beam after filtration and collimation
- d. kilovoltage control
- e. open-ended cylinder/rectangle
- f. scatter radiation
- g. x-ray beam penetration
- h. energy source for radiation production
- i.  $\frac{1}{60}$  second margin of error
- j. comparable to #2 size film packet
- k. milliamperage control
- l. lead
- m.  $\frac{1}{60}$  of a second
- n. electrical current reversal blocking
- o. x-rays
- p. measures electrical current flow
- q. flow and reversal of electrical current

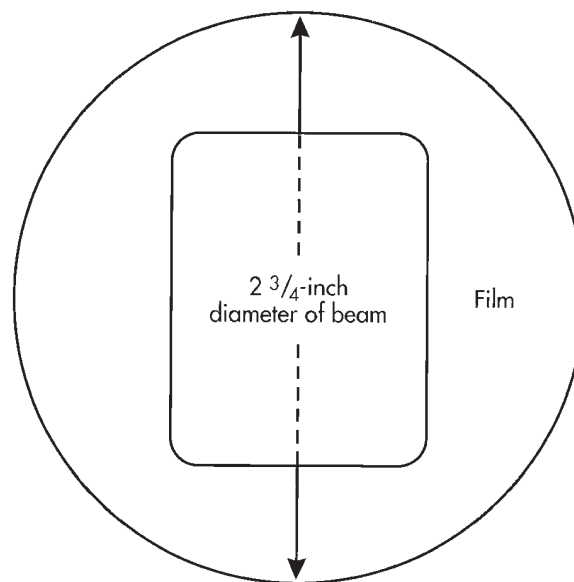
### IV. Illustrations

1. (Figure 2-1) Identify the lettered components in this diagram of the tube head of a dental x-ray machine.



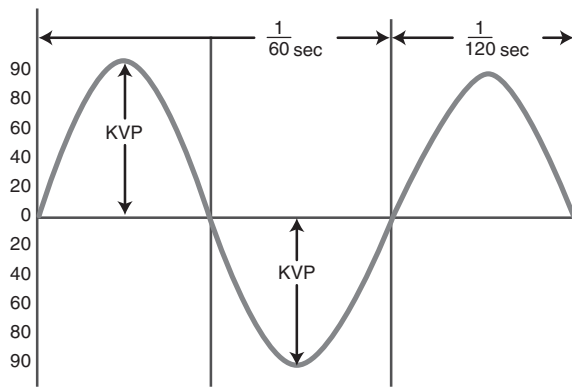
- a.
- b.
- c.

2. (Figure 2-2) Outline in red the areas that would be exposed by the x-ray beam that do not contribute to the image when using circular collimation. Do the same in blue for rectangular collimation.

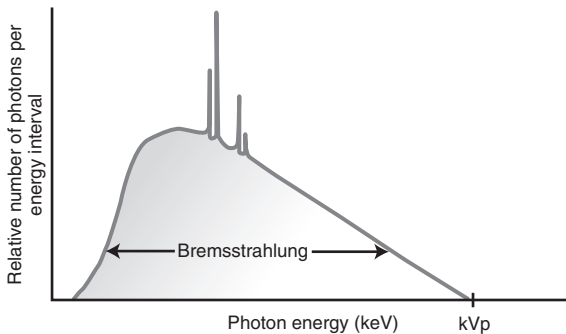




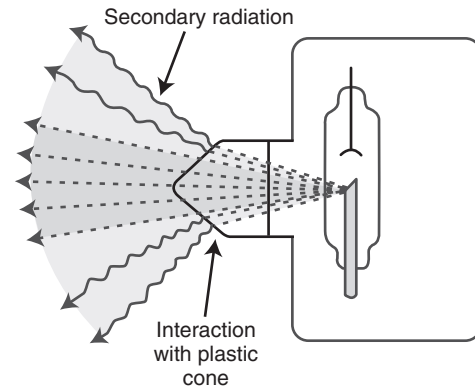
3. (Figure 2-3) Explain how this diagram of alternating current shows the effect of dental x-rays.



4. (Figure 2-4) Indicate where characteristic x-rays are shown on this diagram.



5. (Figure 2-5) What is the remedy for the condition illustrated on this diagram?



## V. Complete These Statements

- The closed-end pointed cone should not be used as a PID because it creates \_\_\_\_\_.
- The diameter of the x-ray beam for intraoral radiographs, measured at the face, should be no larger than \_\_\_\_\_.
- Filtration of the dental x-ray beam is necessary because the beam contains \_\_\_\_\_, \_\_\_\_\_ x-rays.
- In a dental x-ray machine operating at 75kVp, the required total filtration would be \_\_\_\_\_.
- If the kilovoltage is increased with no other change in exposure factors, the resultant film will appear \_\_\_\_\_ and \_\_\_\_\_.

6. Limiting the size of the x-ray beam is called \_\_\_\_\_.
7. On the control panel of the x-ray machine the penetrating power of the x-ray beam is controlled by the \_\_\_\_\_ dial and the number of x-rays produced is controlled by the \_\_\_\_\_ dial.
8. In real time, 20 impulses represent \_\_\_\_\_ second.
9. Limiting the size of the x-ray beam to just slightly larger than the actual size of the film packet is done by using \_\_\_\_\_.
10. Various new dental x-ray machine models are designed to supply \_\_\_\_\_ rectification in which the portion of the alternating cycle is reversed.
11. The term \_\_\_\_\_ is used to denote the maximum voltage that is described by the sine wave that plots the alternation of the current.
12. Some dental x-ray machines have preset fixed milliamperage choices, usually at \_\_\_\_\_, \_\_\_\_\_, or \_\_\_\_\_ mA.
13. The x-ray at the midpoint of the beam is known as the \_\_\_\_\_ ray.
14. Radiation protection codes in many states require the use of lead-lined, \_\_\_\_\_ PIDs.
15. The three parameters of the dental x-ray beam that are adjusted from the control panel are (1) \_\_\_\_\_, (2) \_\_\_\_\_, and (3) \_\_\_\_\_.

## VI. Multiple Choice

Select the best answer.

1. Filters are used in the x-ray beam to
  - a. increase density
  - b. reduce density
  - c. reduce exposure time
  - d. correct the size of the beam
  - e. reduce patient radiation dose
2. Proper collimation of the x-ray beam for film size and focal-film distance will
  - a. improve image definition
  - b. increase radiographic contrast
  - c. increase the intensity of the central beam
  - d. increase secondary radiation
  - e. reduce primary radiation
3. The best way to describe the penetration of an x-ray beam is by its
  - a. half-value layer
  - b. kilovoltage
  - c. milliamperage
  - d. rad output
  - e. roentgen output
4. The milliamperage control dial on the dental x-ray machine
  - a. regulates the step-up transformer
  - b. determines the penetration of the x-ray
  - c. regulates the quality of the radiation
  - d. regulates the quantity of the radiation
  - e. regulates scatter radiation
5. You have taken a radiograph of a patient with a large skeletal build. The resulting image does not show the bone trabeculation well and appears to be underpenetrated. The adjustment that should be made for the retake is
  - a. reduce the mA
  - b. reduce the exposure time
  - c. increase the kVp
  - d. reduce the kVp
  - e. check the processing solution temperature

6. In taking the radiograph, you did not center the beam on the film in the patient's mouth. The resulting film will show
  - a. fogging
  - b. overlapping
  - c. elongation
  - d. collimator cutoff (cone cutting)
  - e. foreshortening
7. The dental x-ray machine in your office operates at 90 kVp and thus is required to have a total filtration of
  - a. 2.75 inches of aluminum
  - b. 2.5 inches of aluminum
  - c. 2.0 mm of aluminum
  - d. 2.5 mm of aluminum
  - e. 1.5 mm of aluminum
8. The radiation inspector comes to your office and tells you that your x-ray beam has an HVL of 1.00 mm of aluminum. You should
  - a. feel assured that the beam meets the recommended standards
  - b. be concerned because of the unnecessary secondary radiation to your patients
  - c. be concerned because the beam is too penetrating
  - d. add more filtration
  - e. use a different PID
9. The x-ray beam from a conventional dental machine is
  - a. a continuous beam
  - b. a convergent beam
  - c. a continuous divergent beam
  - d. a pulsating divergent beam
  - e. none of the above
10. Using a 16-inch focal-film distance, the diameter of the beam measured at the patient's face should be no larger than
  - a. 1 inch
  - b. 3 inches
  - c. 2.75 cm
  - d. 1.5 cm
  - e. 2.75 inches
11. For x-ray timers calibrated in impulses, how many impulses are there in a second?
  - a. 10
  - b. 30
  - c. 60
  - d. 120
  - e. 15
12. The intensity of the beam is affected by the
  - a. kilovolt peak
  - b. milliamperage
  - c. exposure time
  - d. focal-film distance
  - e. all of the above
13. How many times per second is the polarity reversed in a dental x-ray machine operating on an alternating current?
  - a. 30
  - b. 15
  - c. 60
  - d. 45
  - e. none of the above
14. The high-voltage circuit in the dental x-ray machine requires voltage in the range of 65,000 to 100,000, which is achieved by the use of the
  - a. step-up transformer
  - b. high-tension circuit
  - c. autotransformer
  - d. low-tension circuit
  - e. step-down transformer
15. Which of the following materials is most resistant to x-radiation?
  - a. copper
  - b. molybdenum
  - c. tungsten
  - d. lead
  - e. aluminum

---

## VII. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

1. Milliamperage determines the speed of the electrons. **T/F**
2. The dental x-ray tube is self-rectified. **T/F**
3. The dental x-ray beam is homogeneous. **T/F**
4. Kilovoltage determines the penetration of the beam. **T/F**
5. In 60-cycle alternating current, there are 30 pulses of x-ray per second. **T/F**

# Image Formation

## Educational Objectives

*After reading Chapter 3 of the textbook and completing this exercise, the student will*

1. Understand the principles of image formation and the factors that influence the image in dental radiography.
2. Be able to apply these principles to the clinical situation in taking proper radiographs with the least amount of radiation exposure to the patient.

## I. Definitions

Define/explain the following terms.

1. Actual focal area \_\_\_\_\_  
\_\_\_\_\_
2. Bisecting-angle technique \_\_\_\_\_  
\_\_\_\_\_
3. Blurred image \_\_\_\_\_  
\_\_\_\_\_
4. Contrast \_\_\_\_\_  
\_\_\_\_\_
5. Detail \_\_\_\_\_  
\_\_\_\_\_
6. Effective focal area \_\_\_\_\_  
\_\_\_\_\_
7. Film density \_\_\_\_\_  
\_\_\_\_\_
8. Film fog \_\_\_\_\_  
\_\_\_\_\_
9. Focal-film distance (FFD) \_\_\_\_\_  
\_\_\_\_\_

10. Illuminator \_\_\_\_\_  
\_\_\_\_\_
11. Image magnification \_\_\_\_\_  
\_\_\_\_\_
12. Inverse square law \_\_\_\_\_  
\_\_\_\_\_
13. Long-scale contrast \_\_\_\_\_  
\_\_\_\_\_
14. Object density \_\_\_\_\_  
\_\_\_\_\_
15. Object-film distance (OFD) \_\_\_\_\_  
\_\_\_\_\_
16. Paralleling technique \_\_\_\_\_  
\_\_\_\_\_
17. Penumbra \_\_\_\_\_  
\_\_\_\_\_
18. Recessed tube (recessed target) \_\_\_\_\_  
\_\_\_\_\_
19. Short-scale contrast \_\_\_\_\_  
\_\_\_\_\_
20. Umbra \_\_\_\_\_  
\_\_\_\_\_

## II. Comprehension Exercise

1. What factors determine film contrast?
  
  
  
  
  
  
  
  
  
  
2. What is the ideal technique and setting for viewing radiographs?

3. What is the importance of the target area size?
4. What are the factors that influence image detail?
5. What is the ideal relationship in intraoral radiography of the central ray, tooth, and film?  
Can this be achieved?
6. Does the patient receive a larger radiation dose with the longer exposures in the 16-inch FFD technique than with a comparable radiograph using the 8-inch FFD technique?
7. Explain how an increased FFD compensates for an increased OFD while using the paralleling radiographic exposure technique?
8. Why is there less image magnification with a 12-inch FFD than with an 8-inch FFD?

9. Name the possible types of movement that could occur in dental radiography and their respective consequences.
10. What are the advantages of using a 90-kVp setting rather than a 65-kVp setting?
11. Why is an FFD of greater than 16 inches not recommended?
12. What criteria must be met in terms of definition, image enlargement, and distortion to produce the “ideal radiograph” of a tooth or other structure?
13. What factors determine object contrast?
14. What would the result be of using an FFD of less than 8 inches?



15. What is meant by the concept of a recessed tube (recessed target)? What is its purpose?
16. Explain the difference between long-scale and short-scale film contrast. How are they determined?
17. When changing from an 8-inch FFD to a 16-inch FFD, what changes, if any, must be made to the collimator?
18. Explain the inverse square law. Give two clinical applications of its use.
19. What are the advantages of the 16-inch FFD technique over the 8-inch technique?
20. What is the ultimate goal of dental radiography regardless of the type of imaging system used?

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

#### Column A

- \_\_\_\_\_ 1. blurred image
- \_\_\_\_\_ 2. tooth-film position
- \_\_\_\_\_ 3. right-angle technique
- \_\_\_\_\_ 4. long-scale contrast
- \_\_\_\_\_ 5. inverse square law
- \_\_\_\_\_ 6. penumbra
- \_\_\_\_\_ 7. radiolucent
- \_\_\_\_\_ 8. illuminator
- \_\_\_\_\_ 9. focal area size
- \_\_\_\_\_ 10. short-scale contrast
- \_\_\_\_\_ 11. radiopaque
- \_\_\_\_\_ 12. thin film
- \_\_\_\_\_ 13. umbra
- \_\_\_\_\_ 14. dense film
- \_\_\_\_\_ 15. density

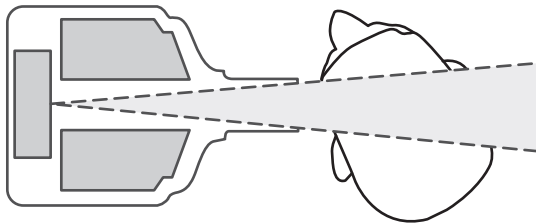
#### Column B

- a. unsharpness
- b. degree of blackness
- c. high contrast
- d. paralleling technique
- e. x-ray intensity
- f. viewbox
- g. overexposed
- h. white (LIGHT) areas
- i. sharpness
- j. object-film distance
- k. patient movement
- l. secondary radiation
- m. underexposure
- n. bisecting method
- o. low contrast
- p. black (DARK) areas
- q. detail

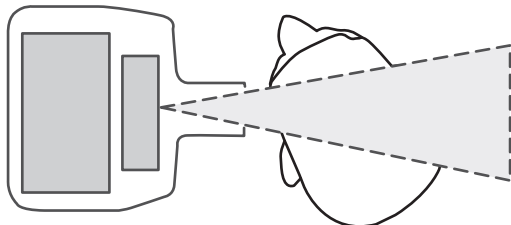
### IV. Illustrations

1. (Figure 3-1) Which tube head (used to produce the same film) will result in greater radiation exposure to the patient: A or B? Or would the patient receive the same amount of radiation exposure?

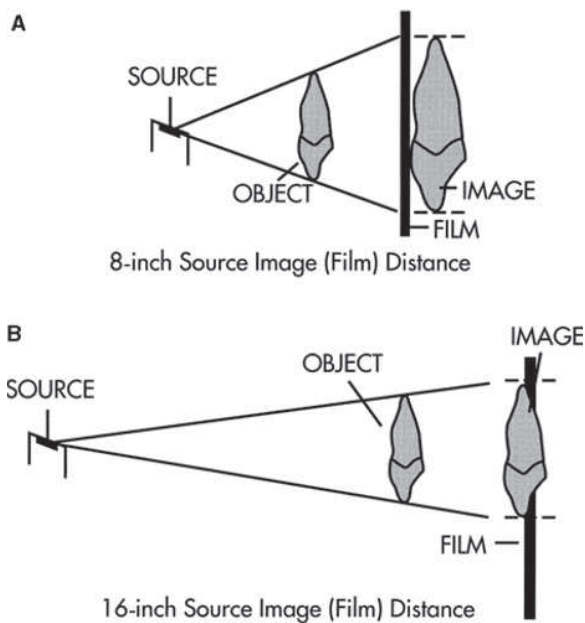
A



B



2. (Figure 3-2) If the exposure time for position A of the focal area is 20 impulses at 65 kVp and 10 mA, what would the exposure time be at position B, with the same kVp and mA, to produce the same radiograph?




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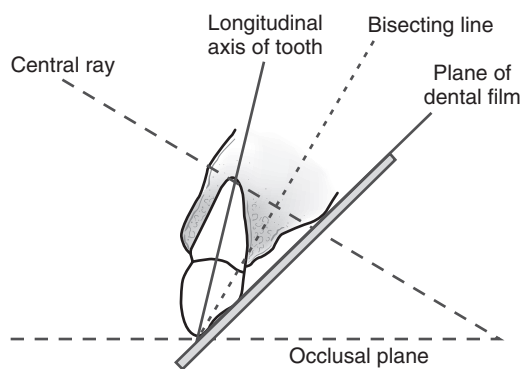


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3. (Figure 3-3) In this diagram of the bisecting technique how would you describe the image that is produced?




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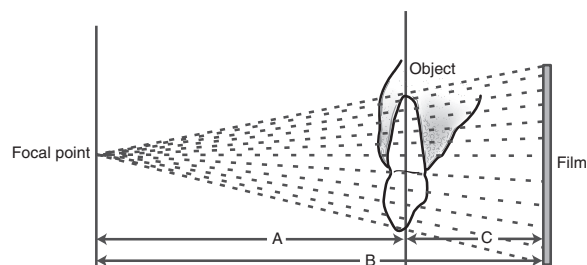


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4. (Figure 3-4) Label the focal-film, object-film, and focal-object distances.



a.

b.

c.

5. (Figure 3-5) In this five-step density scale, between which areas is there the greatest contrast? Which areas have the least contrast?




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## V. Complete These Statements

1. At present, most dental x-ray machines operate in the kVp range of \_\_\_\_\_.
2. The size of the focal area at the anode in the dental x-ray machine influences greatly the \_\_\_\_\_ of the image.
3. The two types of related densities that are factors in image formation are the \_\_\_\_\_ and \_\_\_\_\_ densities.
4. The milliamperage range for an intraoral x-ray machine is \_\_\_\_\_.
5. Image \_\_\_\_\_ is the visual quality of a radiograph that depends on definition or sharpness.
6. Using an aluminum step wedge, large gray areas occur when using a \_\_\_\_\_ -kVp setting as compared with a 65-kVp setting.
7. The difference in the degree of blackness between adjacent areas on a radiograph is the \_\_\_\_\_.
8. Two advantages of the 16-inch FFD over the 8-inch FFD are \_\_\_\_\_ and \_\_\_\_\_.
9. In a periapical radiograph, the milliamperage required for an exposure to produce an acceptable radiograph is determined mainly by the \_\_\_\_\_.
10. Many in the field of dental radiography believe that the human eye can detect changes better in the \_\_\_\_\_ -kVp to \_\_\_\_\_ -kVp range.
11. The main disadvantage of the bisecting technique for periapical radiography is \_\_\_\_\_.
12. The total energy in the x-ray beam in a specific area and at a given time is called the \_\_\_\_\_.
13. The actual focal area size is \_\_\_\_\_ than the effective focal area size in a dental x-ray tube.
14. The limiting factor on how small the focal area can be in the dental x-ray tube is the \_\_\_\_\_.
15. \_\_\_\_\_ is the term that describes the area of sharpness in an acceptable radiograph.

## VI. Multiple Choice

Select the best answer.

1. A 16-inch cylinder is used in the paralleling technique to
  - a. reduce secondary radiation
  - b. avoid magnification of the image
  - c. avoid distortion of the image
  - d. avoid superimposition of anatomic structures
  - e. facilitate correct vertical angulation of the position-indicating device (PID)
2. As the distance between the end of the PID and the film increases, the
  - a. intensity of the x-ray beam decreases
  - b. possibility of film fogging decreases
  - c. density of the film image increases
  - d. possibility of collimator cutoff decreases
  - e. sharpness of the film is affected
3. Image sharpness on a radiograph is increased by
  - a. using a large focal spot size
  - b. using a small focal spot size
  - c. increasing OFD
  - d. decreasing target skin distance
  - e. increasing exposure time
4. You have decided to switch the PID in your office, replacing the 8-inch cylinder with a 16-inch cylinder. Using D-speed film the milliamperage will remain the same, as will the kilovolt peak. The old exposure for lower premolars was 12 impulses; the new exposure to obtain films of equal density will be
  - a. 40 impulses
  - b. 30 impulses
  - c. 20 impulses
  - d. 1 second
  - e. 48 impulses
5. As stated in the previous question, after changing to a 16-inch PID you decide to change from D- to E-speed film. The new exposure at the same milliamperage and kilovolt peak for the lower premolar will be
  - a. 80 impulses
  - b. 24 impulses
  - c. 10 impulses
  - d. 1 second
  - e. 30 impulses
6. The most likely cause for a film with very poor definition is
  - a. a large focal area
  - b. a very short FFD
  - c. patient movement
  - d. use of the bisecting technique
  - e. use of the paralleling technique
7. A radiograph that has many dark and light areas but few gray areas is said to have
  - a. high density
  - b. low density
  - c. high contrast
  - d. low contrast
  - e. none of the above
8. To increase contrast, the operator should decrease
  - a. exposure time
  - b. milliamperage
  - c. OFD
  - d. film speed
  - e. kilovolt peak
9. Use of a kilovolt peak between 45 and 65 produces
  - a. scatter radiation
  - b. fogging
  - c. a blurred image
  - d. an underexposed film
  - e. none of the above

10. The difference in degrees of blackness on a radiograph is called
  - a. density
  - b. tone
  - c. contrast
  - d. fogging
  - e. shades
11. A long FFD is desirable because
  - a. more radiation is absorbed by the tissues
  - b. the resulting radiation is more penetrating
  - c. more soft radiation strikes the object
  - d. the central rays of the primary beam are less divergent
  - e. overexposure rarely occurs
12. Radiographs should always be viewed
  - a. in a well-lit room
  - b. on a viewbox
  - c. in the operatory
  - d. by holding them up to a ceiling light
  - e. using light from a window
13. Which of the following materials is most effective in absorbing x-rays?
  - a. gold
  - b. composite
  - c. enamel
  - d. acrylic
  - e. dentin
14. If the intensity of a beam of radiation is 12 at a point 12 inches from the target, the intensity of the beam at 24 inches is
  - a. 2
  - b. 3
  - c. 4
  - d. 5
  - e. 6
15. You have taken a radiograph of a patient. The resulting image is thin (light). The adjustment that should be made for the retake is
  - a. reduce the kilovolt peak
  - b. reduce the exposure time
  - c. increase the milliamperage
  - d. reduce the milliamperage
  - e. decrease the processing solution temperature
16. If the distance from the source of radiation to the target film is decreased and no other adjustments are made, the resultant radiograph will
  - a. be lighter
  - b. be darker
  - c. be more defined
  - d. have an increased penumbra
  - e. be unchanged
17. Changing from 75 kVp to 90 kVp will
  - a. increase the radiolucency of the resultant radiograph
  - b. decrease radiographic density
  - c. decrease radiographic contrast
  - d. increase radiographic contrast
  - e. increase radiographic exposure time
18. Which of the following causes film fog on radiographs?
  - a. underexposure
  - b. scattered radiation
  - c. improper safelighting
  - d. light leak in the darkroom
  - e. processing solutions that are too cold
    - (1) a, b, c,
    - (2) a, b, c, d
    - (3) a, b, e
    - (4) b, c, d
    - (5) b, c, d, e
    - (6) c, d, e

19. If the PID is 2 inches away from the patient's skin instead of almost touching, the resulting radiograph will be
- underexposed
  - overexposed
  - overpenetrated
  - foreshortened
  - underpenetrated
20. The criteria for an acceptable radiograph include
- proper definition
  - proper detail
  - sharpness
  - desirable contrast
  - desirable density
  - all of the above

## VII. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

- The two types of related densities that are factors in image formation are the object density and the film density. **T/F**
- Low-contrast films appear mainly black and white with very few gray tones. **T/F**
- The smaller the focal area at the anode is, the better the image detail will be. **T/F**
- The most common focal film distances (FFDs) used in dentistry are 8, 12, and 20 inches. **T/F**
- Image detail is not affected by movement. **T/F**

## Educational Objectives

*After reading Chapter 4 of the textbook and completing this exercise, the student will*

1. Know and understand the imaging systems available in dental radiography today.
2. Be able to apply this knowledge to clinical situations that call for the use of intraoral panoramic or extraoral projections, as well as their processing and duplication.

## I. Definitions

Define/explain the following terms.

1. ANSI film rating \_\_\_\_\_  
\_\_\_\_\_
2. Characteristic curve \_\_\_\_\_  
\_\_\_\_\_
3. Cassette \_\_\_\_\_  
\_\_\_\_\_
4. Double emulsion \_\_\_\_\_  
\_\_\_\_\_
5. Double-film packet \_\_\_\_\_  
\_\_\_\_\_
6. Extraoral projection \_\_\_\_\_  
\_\_\_\_\_
7. Film base \_\_\_\_\_  
\_\_\_\_\_
8. Film contrast \_\_\_\_\_  
\_\_\_\_\_
9. Film duplication \_\_\_\_\_  
\_\_\_\_\_



10. Film emulsion \_\_\_\_\_  
\_\_\_\_\_
11. Film reversal \_\_\_\_\_  
\_\_\_\_\_
12. Film sensitivity \_\_\_\_\_  
\_\_\_\_\_
13. Film-screen system \_\_\_\_\_  
\_\_\_\_\_
14. Fluorescence \_\_\_\_\_  
\_\_\_\_\_
15. Fog \_\_\_\_\_  
\_\_\_\_\_
16. Intensifying screen \_\_\_\_\_  
\_\_\_\_\_
17. Intensifying screen speed \_\_\_\_\_  
\_\_\_\_\_
18. Orientation dot \_\_\_\_\_  
\_\_\_\_\_
19. Phosphor \_\_\_\_\_  
\_\_\_\_\_
20. Rare earth screen \_\_\_\_\_  
\_\_\_\_\_

## II. Comprehension Exercise

1. What determines film speed? What film speed should be used?
  
  
  
  
  
  
  
  
  
2. Why should the dental professional consult the ANSI rating as opposed to the manufacturer's descriptive names when establishing the desired film speed for an exposure?

3. What special precautions must be taken in the darkroom when loading cassettes and processing extraoral film?
4. What are the advantages of using rare earth intensifying screens?
5. Explain the relationship between the size of the silver halide crystals and the detail/definition of the resulting radiograph.
6. What will happen if an intensifying screen is scratched accidentally in the darkroom?
7. Explain the significance of film-screen compatibility.
8. How can the left side of the patient be differentiated from the right on extraoral and panoramic films?

9. How does the use of intensifying screens reduce the radiation needed for radiographs?
10. What is the purpose of the lead foil in the film packet?
11. Name the three main sources of film fog and briefly explain each.
12. Explain the difference between a double-emulsion film and a double-film packet.
13. How would you compare the mAs needed for E-speed film with that needed for D-speed film?
14. Describe the process of radiographic duplication.

15. How would you compare the radiation exposure to the patient using D-speed film with that using E-speed film?
16. What are silver halides? How are they used in dentistry?
17. What determines the speed of an intensifying screen?
18. List three uses for duplicate radiographs in dentistry.
19. Does the emulsion differ on a bitewing from the emulsion on a periapical film? If so, why?
20. Why should intensifying screens be used in extraoral radiography in spite of the loss of definition exhibited on the resultant radiographs?

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

*Column A*

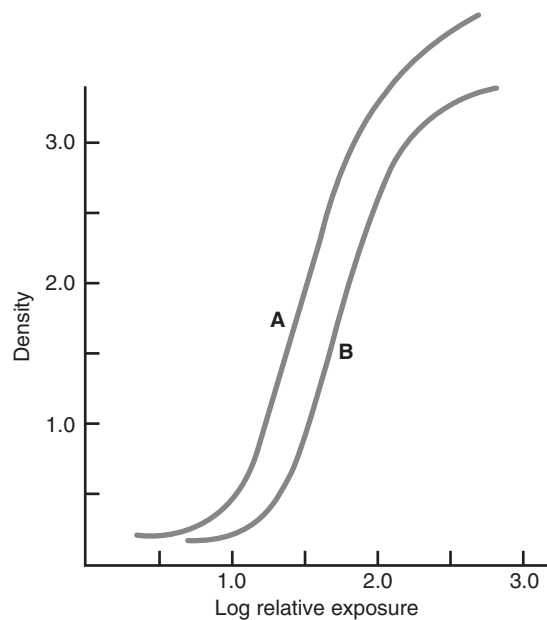
- \_\_\_\_\_ 1. lead foil backing
- \_\_\_\_\_ 2. pediatric film size
- \_\_\_\_\_ 3. film fog
- \_\_\_\_\_ 4. light fog
- \_\_\_\_\_ 5. film density
- \_\_\_\_\_ 6. single emulsion
- \_\_\_\_\_ 7. flexible cassette
- \_\_\_\_\_ 8. occlusal film
- \_\_\_\_\_ 9. intensifying screen
- \_\_\_\_\_ 10. F-speed film
- \_\_\_\_\_ 11. green light
- \_\_\_\_\_ 12. film duplication
- \_\_\_\_\_ 13. orientation dot
- \_\_\_\_\_ 14. film packet
- \_\_\_\_\_ 15. chemical fog

*Column B*

- a. large halide grains
- b. gelatin
- c. secondary radiation
- d. #4
- e. panoramic radiography
- f. film mounting
- g. decreased patient exposure
- h. processing solutions
- i. third-party payers
- j. overall gray appearance
- k. film emulsion
- l. light leak
- m. #0
- n. rare earth intensifying screens
- o. degree of blackness
- p. duplicating film
- q. light-tight

## IV. Illustrations

1. (Figure 4-1) In this H and D curve explain, which film, A or B, would give the patient the least amount of radiation exposure.




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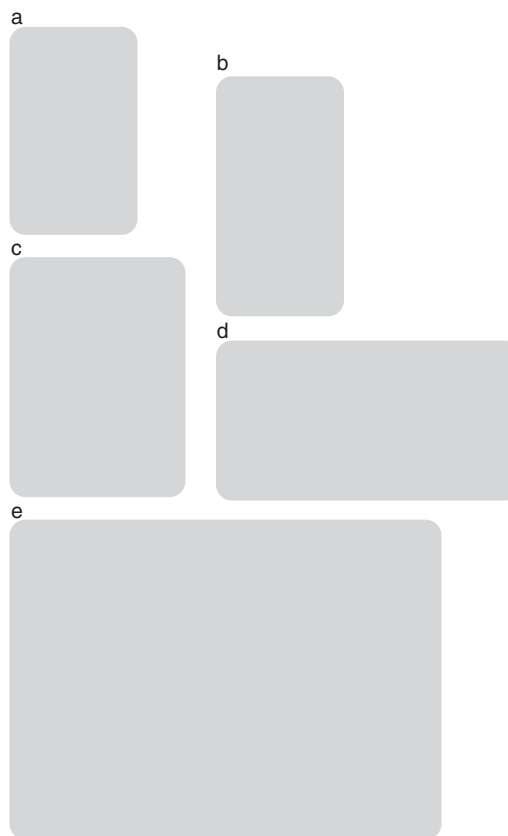


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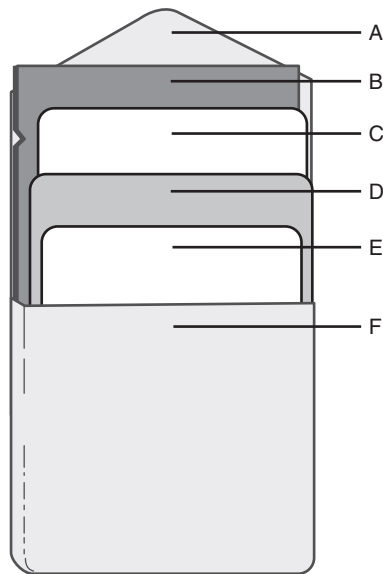
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2. (Figure 4-2) Label the film packets with their appropriate film size.



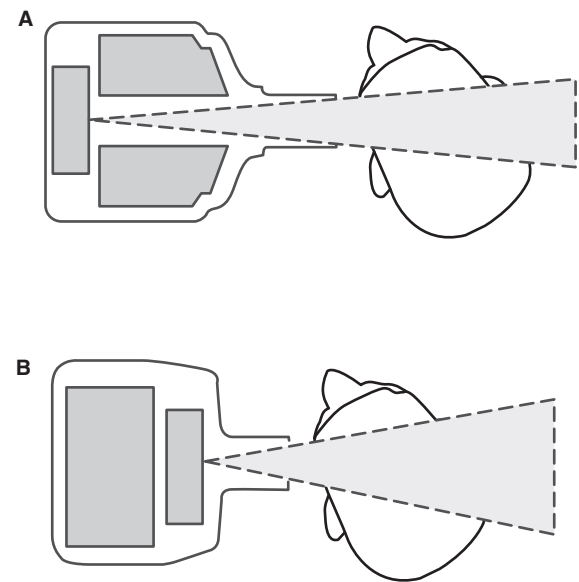
- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_
- e. \_\_\_\_\_

3. (Figure 4-3) Label (A to F) the components of the intraoral film packet.



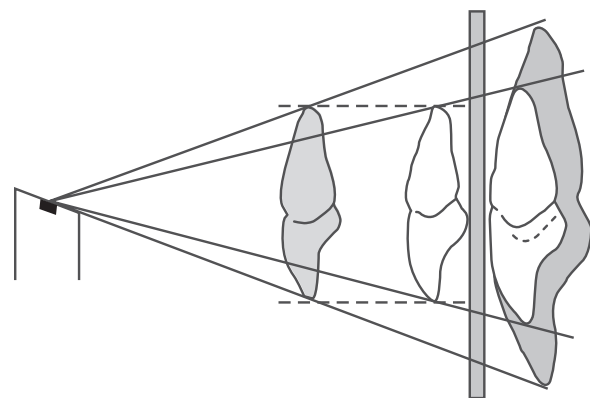
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

4. (Figure 4-4) What is the difference in exposure times between A and B? Explain.



- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

5. (Figure 4-5) What is the relationship between OFD and image magnification as depicted below?



- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

## V. Complete These Statements

1. At present the ANSI dental film group that gives the patient the least amount of radiation exposure is \_\_\_\_\_.
2. The \_\_\_\_\_ presently used in dentistry are film, electronic sensors, and film-screen combinations.
3. In the early days of dental radiography, the x-ray \_\_\_\_\_ consisted of glass photographic plates or film cut into pieces and wrapped in black paper or rubber dam.
4. Long bitewing film packets are considered to be size # \_\_\_\_\_.
5. The plot for dental x-ray film that expresses the relationship between density of the film and the log relative exposure is the \_\_\_\_\_.
6. Extraoral films are processed in the \_\_\_\_\_ as intraoral films.
7. The main advantage in using rare earth intensifying screens is \_\_\_\_\_.
8. F-speed film will reduce radiation exposure by \_\_\_\_\_ % when compared to D-speed film.
9. When comparing radiographic detail, it can be said that film-screen combinations produce \_\_\_\_\_ detail when compared to film alone.
10. The component of an x-ray film described as a thin transparent coating that is placed over the emulsion is called the \_\_\_\_\_.
11. Duplicating film has a \_\_\_\_\_ emulsion.
12. Duplicating film has the emulsion on the \_\_\_\_\_ side of the film.
13. Double packets require slightly \_\_\_\_\_ exposure than single films.
14. It is said that the \_\_\_\_\_ the silver halide crystals are, the faster the speed of the film.

## VI. Multiple Choice

Select the best answer.

1. When comparing ANSI film rated D with ANSI film rated F, one can say that
  - a. F film is less sensitive
  - b. F film requires more radiation
  - c. F film results in more exposure to the patient
  - d. F film requires less exposure time
  - e. None of the above
2. Rare earth intensifying screens produce
  - a. blue light
  - b. red light
  - c. green light
  - d. ultraviolet light
  - e. purple light



3. The best way to clean the intensifying screens in extraoral cassettes is with
  - a. detergent
  - b. disinfectant solution
  - c. cold sterilizing solution
  - d. soapy water
  - e. a wire brush
4. Film fog occurs when all or part of a radiograph is darkened by
  - a. an imbalance or exhaustion of processing solutions
  - b. a light leak
  - c. improper safelighting
  - d. scatter radiation
  - e. All of the above are potential sources.
5. Which of the following statement is false concerning film duplication?
  - a. The films to be duplicated are in close contact with the duplicating film.
  - b. The shiny side of the film is the nonemulsion side.
  - c. If less film density is needed on the duplicate radiograph, the exposure time is shortened.
  - d. The raised portion of the orientation dot faces toward the light source.
  - e. The radiographs being duplicated should be removed from their respective mounts.
6. Flexible cassettes are
  - a. not used because of cracking of the emulsion
  - b. are used in all panoramic units
  - c. are used in some panoramic units
  - d. are used for lateral oblique projections only
  - e. none of the above
7. Intraoral film packets must be
  - a. resistant to salivary seepage
  - b. flexible
  - c. light-tight
  - d. easy to open in the darkroom
  - e. all of the above
8. To what does the term *film speed* refer?
  - a. the developing time needed
  - b. sensitivity to x-radiation
  - c. half-life
  - d. degree of blackness on the exposed radiograph
  - e. shelf life
9. The advantage of a film that has emulsion on both sides is that
  - a. the film requires less radiation exposure
  - b. the image produced is less distorted
  - c. the film has less sensitivity to radiation
  - d. processing solutions work better
  - e. the film is easier to mount
10. Which of the following film sizes is considered to be standard adult film?
  - a. size #0
  - b. size #1
  - c. size #2
  - d. size #3
  - e. size #4
11. Nonscreen film is routinely used in extraoral radiography.
  - a. true
  - b. false
12. The intensifying screen that emits blue light and must be used with film that is sensitive to blue light is a
  - a. nonlight screen
  - b. calcium tungstate screen
  - c. rare tungstate screen
  - d. rare earth screen
  - e. phosphor calcium screen
13. The device that converts x-ray energy into visible light is called a(n)
  - a. cassette holder
  - b. step-down transformer
  - c. intensifying screen
  - d. nonscreen film
  - e. screen film

14. If the intensifying screens are not in perfect contact with the film, which of the following will occur?
- The screen may be damaged.
  - The film may be damaged.
  - There will be a light leak.
  - There will be a loss of image sharpness.
  - A thin film will result.
15. What is the major advantage in using the fastest speed film and high kilovolt peak?
- It increases film density.
  - It increases film contrast.
  - It produces a clearer image.
  - It reduces the radiation exposure to the patient.
  - It makes film easier and faster to develop.

## VII. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

- The orientation dot on the film packet is useful in mounting. **T/F**
- The lead foil in the film packet prevents collimator cut-off. **T/F**
- The use of intensifying screens decreases exposure time. **T/F**
- Pediatric film is size #3. **T/F**
- D-speed film is currently recommended for use in dental radiography. **T/F**

# Biologic Effects of Radiation

## Educational Objectives

*After reading Chapter 5 of the textbook and completing this exercise, the student will*

1. Understand the biologic effects of ionizing radiation on human tissue.
2. Be able to relate these concepts to clinical dental radiology.

## I. Definitions

Define/explain the following terms.

1. Acute effects \_\_\_\_\_  
\_\_\_\_\_
2. ALARA principle \_\_\_\_\_  
\_\_\_\_\_
3. Background radiation \_\_\_\_\_  
\_\_\_\_\_
4. Cell recovery \_\_\_\_\_  
\_\_\_\_\_
5. Chronic effects \_\_\_\_\_  
\_\_\_\_\_
6. Critical organs \_\_\_\_\_  
\_\_\_\_\_
7. Dose \_\_\_\_\_  
\_\_\_\_\_
8. Dose equivalent \_\_\_\_\_  
\_\_\_\_\_
9. Erythema dose \_\_\_\_\_  
\_\_\_\_\_
10. Exposure \_\_\_\_\_  
\_\_\_\_\_

11. Genetic cells \_\_\_\_\_  
\_\_\_\_\_
12. Indirect effects of radiation \_\_\_\_\_  
\_\_\_\_\_
13. Latent period \_\_\_\_\_  
\_\_\_\_\_
14. Primary radiation \_\_\_\_\_  
\_\_\_\_\_
15. Radiation caries \_\_\_\_\_  
\_\_\_\_\_
16. Rem \_\_\_\_\_  
\_\_\_\_\_
17. Risk estimate \_\_\_\_\_  
\_\_\_\_\_
18. Secondary radiation \_\_\_\_\_  
\_\_\_\_\_
19. Somatic cells \_\_\_\_\_  
\_\_\_\_\_
20. Threshold effect \_\_\_\_\_  
\_\_\_\_\_

## II. Comprehension Exercise

1. Explain the difference between radiation exposure and radiation dose.
  
  
  
  
  
  
  
  
  
  
2. What news events have created public concern of radiation exposure? What can dental professionals do to allay the fears associated with these occurrences?

3. What is the difference between a roentgen, a rad, and a rem?
4. What is the output of an x-ray machine? How is it measured?
5. Explain why the walls of the dental operatory do not become radioactive after continuous exposure to radiation.
6. Explain the difference between a localized dose and a total body dose.
7. What body cells are the most sensitive to ionizing radiation?
8. What is the difference between direct or indirect effects? Which of the two is more prevalent?
9. What is the primary mechanism for tissue change resulting from dental x-ray exposure?

10. Approximately what is the facial exposure from a full-mouth x-ray survey? How is it calculated?
11. How much background radiation does the population at sea level receive each year? What are the major sources of background radiation?
12. How does one handle the dental radiographic needs of a pregnant patient?
13. What are mutations? What can cause mutations in offspring?
14. Name some risks encountered in everyday living that compare with the risks of developing cancer from dental radiation.
15. Explain the risk vs. benefit concept.

16. What is the difference between primary and secondary radiation?
17. What is the erythema dose for facial skin? Is this an important consideration in dental radiology?
18. What does the latent period refer to in dental radiology?
19. What are the units for measuring radiation based on the metric system? How do these units relate to the conventional system?
20. Explain the difference between the acute and chronic effects of radiation.

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

#### *Column A*

- \_\_\_\_\_ 1. photoelectric effect
- \_\_\_\_\_ 2. rad
- \_\_\_\_\_ 3. total body exposure
- \_\_\_\_\_ 4. ionization
- \_\_\_\_\_ 5. acute effects of radiation
- \_\_\_\_\_ 6. sievert
- \_\_\_\_\_ 7. indirect effects of radiation
- \_\_\_\_\_ 8. attenuation
- \_\_\_\_\_ 9. dose equivalent
- \_\_\_\_\_ 10. leukemia risk
- \_\_\_\_\_ 11. Thompson scatter
- \_\_\_\_\_ 12. roentgen
- \_\_\_\_\_ 13. Compton effect
- \_\_\_\_\_ 14. cell recovery
- \_\_\_\_\_ 15. radiation therapy

#### *Column B*

- a. free radical formation
- b. happens 30% of the time
- c. reduced x-ray beam intensity
- d. more than 100rads
- e. coherent scatter
- f. nuclear accident
- g. 100erg/g
- h. cells' repair process
- i. low-level radiation
- j. radiation caries
- k. happens 62% of the time
- l. 100rem
- m. qualifying factor
- n. free radicals
- o. 1 esu/cc of air
- p. kilovoltage
- q. absorption of x-rays

### IV. Illustrations

1. Draw and label a linear nonthreshold dose-response curve.

2. Illustrate the Compton effect of x-ray interaction.



3. Draw a patient's face and illustrate primary and secondary radiation (as found in Chapter 6 of the textbook).

4. Illustrate the difference between localized and total body exposure on a figure of a seated patient.

5. Draw a nonlinear threshold dose-response curve.

## V. Complete These Statements

1. The type of interaction between an x-ray photon and a loosely bound orbital electron is characterized by the \_\_\_\_\_ effect.
2. A pregnant woman in her sixth month can have, if deemed necessary, \_\_\_\_\_.
3. Radiation from medicine and dentistry accounts for about \_\_\_\_\_ % of the average annual dose equivalent to the U.S. population.
4. The tissue most sensitive to ionizing radiation is \_\_\_\_\_.
5. Cellular changes caused by ionizing radiation are not passed on to succeeding generations in \_\_\_\_\_ tissue.
6. Our objective for the dental radiographic patient is to use the least amount of radiation to obtain \_\_\_\_\_.
7. The rate at which exposure to ionizing radiation occurs is called the \_\_\_\_\_.
8. The major component of background radiation at sea level is \_\_\_\_\_.
9. The objective for occupational radiation exposure is to keep the exposure as close to \_\_\_\_\_ as possible.

10. The time that elapses between the exposure to ionizing radiation and the appearance of clinical symptoms is called the \_\_\_\_\_.
11. In considering dental radiology the roentgen, the rad, and the rem are \_\_\_\_\_.
12. One gray of radiation is equal to \_\_\_\_\_ rads.
13. An average skin exposure to the patient's face using E-speed film for a full-mouth series is about \_\_\_\_\_.
14. The two mechanisms for tissue damage resulting from radiation exposure are \_\_\_\_\_ and \_\_\_\_\_ formation.
15. An example of an energy wave that will not cause ionization is \_\_\_\_\_, or \_\_\_\_\_.
16. An exposure of radiation is measured in \_\_\_\_\_.
17. The dose-response curve for dental radiation is a \_\_\_\_\_.
18. An \_\_\_\_\_ placed in front of a dental x-ray machine's position-indicating (PID) device can indicate how many roentgens the machine is producing per second.
19. The occupational hazard for the pregnant dental professional under proper conditions should be \_\_\_\_\_.
20. The greatest somatic hazard to patients from dental x-rays is \_\_\_\_\_.

## VI. Multiple Choice

Select the best answer.

1. In taking dental radiographs the greatest dose of radiation to structures in the patient's jaw comes from
  - a. the primary beam
  - b. leakage from the x-ray machine
  - c. scatter from the patient's face
  - d. scatter from the PID
  - e. secondary radiation
2. Ionization has occurred when
  - a. cell death occurs
  - b. photons penetrate matter
  - c. radiant energy is converted to heat
  - d. an electron is displaced from its orbit
  - e. none of the above
3. Which form of radiation can cause ionization of atoms?
  - a. radar
  - b. microwaves
  - c. radio waves
  - d. visible light
  - e. gamma rays
4. The ALARA principle refers to
  - a. obtaining informed consent
  - b. the disinfection procedures recommended in dental radiography
  - c. obtaining diagnostically acceptable radiographs with minimal exposure to radiation
  - d. decreasing the processing time for exposed radiographs
  - e. none of the above

5. Patient radiation dose is related to which of the following?
  - a. length of the exposure
  - b. distance from the source
  - c. shielding and filtration
  - d. time of day
  - e. position of the operator
  - (1) a, b
  - (2) a, b, c
  - (3) a, b, c, d
  - (4) a, c
  - (5) none of the above
6. Which of the following travel at the greatest speed?
  - a. x-rays
  - b. gamma rays
  - c. light
  - d. microwaves
  - e. they all travel at the same speed
7. X-rays that are most likely to be absorbed by the skin are
  - a. those with a short wavelength
  - b. aluminum filtered rays
  - c. those with long wavelengths
  - d. high-energy waves
  - e. sonic waves
8. Which of the following statements concerning background radiation is most accurate?
  - a. It gives us the maximum recommended dosage for radiation exposure.
  - b. It can be avoided if an individual is cautious.
  - c. It is found everywhere.
  - d. It is only present in dental offices and medical facilities.
  - e. None of the above are correct.
9. Arrange the following cells and tissues from most sensitive to least sensitive to ionizing radiation.
  - a. nerve
  - b. bone
  - c. lymphocytes
  - d. gastrointestinal tract
  - (1) b, a, d, c
  - (2) c, a, d, b
  - (3) c, b, a, d
  - (4) c, d, a, b
  - (5) c, d, b, a
10. In recent years the focus of prime concern from the effects of ionizing radiation used in dentistry has centered on
  - a. somatic damage to the patient
  - b. occupational exposure of dental workers
  - c. genetic damage to patients
  - d. cancer induction in patients
  - e. its contribution to background radiation
11. Under the new metric system for measuring dose (SI), the rem is replaced by the
  - a. rad
  - b. gray
  - c. sievert
  - d. becquerel
  - e. curie
12. Which of the following types of scatter radiation occurs most often with dental x-rays?
  - a. Thompson
  - b. Compton
  - c. photoelectric
  - d. coherent
  - e. All of the above occur equally with dental x-rays.

13. The time period between exposure to x-rays and appearance of radiation damage is the
  - a. silent period
  - b. latent period
  - c. waiting period
  - d. refractory period
  - e. gestation period
14. The Compton effect describes
  - a. one type of interaction of x-rays with matter
  - b. cell death
  - c. cell recovery
  - d. cell aberration
  - e. cancerous change
15. The ALARA concept means
  - a. always lower amperage requirements with age
  - b. as low as reasonably achievable
  - c. as low as recording allows
  - d. as level as reasonably achievable
  - e. none of the above
16. An angstrom unit is used to measure
  - a. radiation dose
  - b. radiation exposure
  - c. x-ray wavelength
  - d. half-value layer
  - e. amperage
17. Which of the following statements are correct?
  - a. X-rays can affect all living biologic tissue.
  - b. Developing young immature cells are more sensitive to radiation.
  - c. In dentistry only the primary beam is of concern for safety.
  - d. Changes in adult cells are of short duration and are soon dissipated.
  - (1) b, c, d
  - (2) a, b, c
  - (3) a, c, d, b
  - (4) a, b
18. The unit that describes the amount of x-ray exposure in air is the
  - a. rad
  - b. rem
  - c. roentgen
  - d. gray
  - e. sievert
19. The prime concern for dental personnel taking radiographs under accepted procedures is
  - a. primary radiation
  - b. secondary radiation
  - c. Bremsstrahlung radiation
  - d. classical radiation
  - e. all of the above
20. Which of the following characteristics of body tissue determines its sensitivity to radiation?
  - a. blood flow
  - b. iron content
  - c. oxyhemoglobin concentration
  - d. mitotic rate
  - e. water content

## VII. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

1. Secondary radiation is the radiation that comes directly from the dental x-ray tube. **T/F**
2. A free radical is an uncharged molecule and is initially very unstable. **T/F**
3. Dose is the amount of ionization in the air produced by x-rays. **T/F**
4. Background radiation can only occur naturally in the environment. **T/F**
5. The reproductive cells are not very radiosensitive. **T/F**

## Educational Objectives

*After reading Chapter 6 of the textbook and completing this exercise, the student will*

1. Understand and be able to practice dental radiography in a safe, efficient manner so that the patient receives the smallest possible dose of radiation as the maximum diagnostic information is acquired.

### I. Definitions

Define/explain the following terms.

1. Administrative radiographs \_\_\_\_\_  
\_\_\_\_\_
2. Collimation \_\_\_\_\_  
\_\_\_\_\_
3. Film holder \_\_\_\_\_  
\_\_\_\_\_
4. Filtration \_\_\_\_\_  
\_\_\_\_\_
5. Head leakage \_\_\_\_\_  
\_\_\_\_\_
6. Lead apron \_\_\_\_\_  
\_\_\_\_\_
7. Localizing ring \_\_\_\_\_  
\_\_\_\_\_
8. Primary radiation \_\_\_\_\_  
\_\_\_\_\_
9. Radiation history \_\_\_\_\_  
\_\_\_\_\_
10. Retakes \_\_\_\_\_  
\_\_\_\_\_

11. Secondary radiation \_\_\_\_\_  
\_\_\_\_\_
12. Selection criteria \_\_\_\_\_  
\_\_\_\_\_
13. Thyroid collar \_\_\_\_\_  
\_\_\_\_\_
14. Tube head drift \_\_\_\_\_  
\_\_\_\_\_
15. Useful beam \_\_\_\_\_  
\_\_\_\_\_

## II. Comprehension Exercise

1. What is the problem with mechanical timers in dental x-ray machines? Explain.
2. Explain the effect of kilovoltage peak on patient dosage.
3. Why is the use of closed-ended, pointed cones contraindicated in contemporary dentistry?
4. What is the advantage of using F-speed film? Is there a disadvantage? Explain.

5. Why is the paralleling technique preferred over the bisecting technique in regard to patient dosage?
6. What is the relationship between focal-film distance (FFD) and patient dosage?
7. Give some examples of selection criteria for taking radiographs.
8. Why does a technique that employs overexposure with underdevelopment subject the patient to unnecessary radiation? Explain.
9. What is the present status of administrative radiographs?
10. List six major ways to reduce x-ray dose for patients.

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

#### *Column A*

- \_\_\_\_\_ 1. postoperative radiographs
- \_\_\_\_\_ 2. selection criteria
- \_\_\_\_\_ 3. administrative radiographs
- \_\_\_\_\_ 4. paralleling technique
- \_\_\_\_\_ 5. increased FFD
- \_\_\_\_\_ 6. change from E- to F-speed film
- \_\_\_\_\_ 7. radiation history
- \_\_\_\_\_ 8. mechanical timers
- \_\_\_\_\_ 9. filtration
- \_\_\_\_\_ 10. lead apron

#### *Column B*

- a. decreased exit dose
- b. remove soft wavelengths
- c. medical/dental diagnostic and therapeutic radiation
- d. root tip retrieval
- e. reduce dose by 20%
- f. not to be taken
- g. inaccurate by  $\frac{1}{4}$  of a second
- h. required in many localities
- i. inaccurate by a second
- j. decreased thyroid dose
- k. determines x-rays that are needed
- l. 2  $\frac{3}{4}$ -inch beam diameter

### IV. Illustrations

1. Draw the different relationships of the x-ray beam and secondary radiation to the thyroid gland using both the paralleling and bisecting techniques.

2. Illustrate how less tissue volume is exposed using a 16-inch FFD rather than an 8-inch FFD.



## V. Complete These Statements

1. In an adult patient not prone to caries and clinically negative, bitewing radiographs should be taken every \_\_\_\_\_.
2. All new edentulous patients should \_\_\_\_\_.
3. Radiographs should always be viewed \_\_\_\_\_.
4. Taking radiographs to confirm the fit of restorations should be \_\_\_\_\_.
5. Retaking radiographs because of poor technique results in \_\_\_\_\_.
6. \_\_\_\_\_ is the single most effective factor in reducing radiation exposure to the patient.
7. The thyroid dose in the bisecting method is greater because of \_\_\_\_\_.
8. The use of F-speed film will \_\_\_\_\_.
9. Mechanical timers are \_\_\_\_\_.
10. Kilovoltage of less than 65 should never be used for dental x-rays because \_\_\_\_\_.

## VI. Multiple Choice

Select the best answer.

1. Using an F-speed rather than an E-speed film to produce a radiograph results in
  - a. greater patient exposure
  - b. less patient exposure
  - c. the same exposure time
  - d. a longer processing time
  - e. a shorter processing time
2. All of the following reduce radiation exposure to the patient except
  - a. rectangular collimation
  - b. fast-speed film
  - c. overexposure with underdevelopment
  - d. lead aprons
  - e. aluminum filtration
3. Which of the following combinations of dose reduction methods is most effective for reducing radiation for patients?
  - a. E-speed film, round collimation
  - b. E-speed film, lead apron
  - c. D-speed film, rectangular collimation
  - d. E-speed film, rectangular collimation
  - e. D-speed film, lead apron
4. A dental x-ray machine operating at 75 kVp is required to have a total aluminum filtration of
  - a. 2 mm
  - b. 2.5 mm
  - c. 2 inches
  - d. 2.5 inches
  - e. 2.75 inches
5. Every radiographic retake represents
  - a. an impulse of additional exposure to the patient
  - b. a quadrupling of exposure to the patient
  - c. an unnecessary doubling of patient exposure
  - d. an attempt to improve one's technique without cost to the patient
  - e. None of the above are relevant.

6. Which of these position-indicating devices (PIDs) is least effective in minimizing radiation scatter?
  - a. lead-lined cylinder
  - b. pointed cone
  - c. lead-lined rectangle
  - d. plastic cylinder
  - e. plastic rectangle
7. Radiation history should include all of the following except
  - a. medical radiation exposure
  - b. dental radiation exposure
  - c. therapeutic radiation exposure
  - d. background radiation exposure
  - e. panoramic radiation exposure
8. Lead aprons should be used
  - a. on all patients
  - b. to reassure patients
  - c. to reduce scatter to the film
  - d. only on children
  - e. only on pregnant patients
9. All but which of the following are important to minimize patient exposure to radiation?
  - a. proper collimation
  - b. not utilizing selection criteria to prescribe radiographs
  - c. proper filtration
  - d. darkroom quality assurance programs
  - e. history taking
10. Dental radiographs should be taken
  - a. only if there is pain
  - b. to train students
  - c. for insurance company requests
  - d. routinely every 6 months
  - e. to aid in diagnosis
11. Which of the following results in the greatest reduction to radiation in the patient?
  - a. short developing time
  - b. low kilovoltage peak
  - c. film with fast emulsion speed
  - d. wide primary beam
  - e. high milliamperage
12. According to selection criteria
  - a. an asymptomatic edentulous patient does not require radiographs
  - b. a 14-year-old patient will probably need posterior bitewings
  - c. a panoramic exam is needed for a new edentulous patient
  - d. very few patients need radiographs at 6-month intervals
  - e. All of the above are correct.
13. The maximum diameter of the dental x-ray beam measured at the skin should be no greater than
  - a. 2 mm
  - b. 2.75 inches
  - c. 2 inches
  - d. 2.5 inches
  - e. 2.75 mm
14. Before prescribing dental radiographs, which of the following are needed?
  - a. history of previous radiographs
  - b. clinical examination
  - c. medical history
  - d. dental history
  - e. all of the above
15. The most important use of x-rays in dentistry is
  - a. patient education
  - b. legal protection
  - c. diagnosis
  - d. pain control
  - e. therapy

## VII. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

1. The ALARA principle deals with radiation protection of the patient and operator. **T/F**
2. Pregnant patients may have radiographs taken when they are needed. **T/F**
3. The closed-ended pointed PID is recommended for use in dental radiography. **T/F**
4. Administrative radiographs should be strongly discouraged. **T/F**
5. The dose to the thyroid gland is greater in the bisecting angle technique. **T/F**

## Educational Objectives

*After reading Chapter 7 of the textbook and completing this exercise, the student will*

1. Understand and feel comfortable working with ionizing radiation.

### I. Definitions

Define/explain the following terms.

1. Exposure technique \_\_\_\_\_  
\_\_\_\_\_
2. Film badge \_\_\_\_\_  
\_\_\_\_\_
3. Ionizing chamber \_\_\_\_\_  
\_\_\_\_\_
4. Maximum permissible dose (MPD) \_\_\_\_\_  
\_\_\_\_\_
5. Monitoring device \_\_\_\_\_  
\_\_\_\_\_
6. Pocket dosimeter \_\_\_\_\_  
\_\_\_\_\_
7. Protective barrier \_\_\_\_\_  
\_\_\_\_\_
8. Radiation monitoring \_\_\_\_\_  
\_\_\_\_\_
9. Radiation survey \_\_\_\_\_  
\_\_\_\_\_
10.  $W \times U \times T$  \_\_\_\_\_  
\_\_\_\_\_

---

## II. Comprehension Exercise

1. What does the acronym “CRESO” represent, and how does it apply to operator protection?
2. Where should the operator be positioned when taking radiographs?
3. Explain the significance of the present levels of the MPD.
4. What are the sources of potential radiation exposure to the radiographer?
5. What constitutes adequate shielding in the dental office? Are lead-lined walls always necessary?
6. What is the equation for determining the accumulated lifetime dose for a dental radiographer? What would it be for a 35-year-old?

7. What are the advantages of personnel wearing film badges over a radiation survey?
8. What should the operator “not do” in order to avoid primary beam exposure during a dental radiographic procedure?
9. Can dental workers continue to take radiographs during pregnancy? Explain.
10. List the ways the operator’s occupational dose can be kept to zero.

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### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

*Column A*

- \_\_\_\_\_ 1. occupational MPD
- \_\_\_\_\_ 2. nonoccupational MPD
- \_\_\_\_\_ 3. maximum scatter
- \_\_\_\_\_ 4. film badge
- \_\_\_\_\_ 5. monitoring device
- \_\_\_\_\_ 6. CRESO
- \_\_\_\_\_ 7. lead-lined walls
- \_\_\_\_\_ 8. 6 feet away
- \_\_\_\_\_ 9. minimum scatter
- \_\_\_\_\_ 10. barrier

*Column B*

- a. right angles to the x-ray beam
- b. 5000 mrem
- c. not always necessary
- d. 50 rem/year
- e. radiation shielding
- f. radiation survey
- g. personal radiation exposure
- h. filtration
- i. 500 mrem
- j. proper operator position
- k. lead apron
- l. behind the patient
- m. pocket dosimeter

## IV. Illustrations

1. Draw a diagram of a dental operatory and indicate where the operator should stand when making a radiographic exposure.

2. Draw a diagram identifying the areas of minimum and maximum scatter during dental x-ray exposure.

## V. Complete These Statements

1. Three factors used in calculating the type of barrier needed in a dental office are \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
2. The two methods that can alert dental personnel to the amount of occupational exposure they are receiving are through a \_\_\_\_\_ and by wearing a \_\_\_\_\_.
3. A full-mouth series is equivalent to about \_\_\_\_\_ days of background radiation exposure.
4. The MPD for occupational exposure to ionizing radiation will be \_\_\_\_\_.
5. If a pregnant operator follows proper procedure, there is \_\_\_\_\_ to the fetus.
6. \_\_\_\_\_ construction, if of proper thickness, is sufficient for proper radiation shielding.
7. A film badge reading of 400mR for a 4-week period \_\_\_\_\_.
8. If one is positioned 6 feet from the head of the x-ray machine during an exposure, then \_\_\_\_\_.
9. Under no circumstance should the dental professional \_\_\_\_\_.
10. Operators should not wear their film badges \_\_\_\_\_ their offices.

## VI. Multiple Choice

Select the best answer.

1. At present the recommended MPD for nonoccupationally exposed individuals is
  - a. 500mrem/year
  - b. 5 mrem/year
  - c. 5 rem/year
  - d. 5000mrem/year
  - e. 0.5 mrem/year
2. The occupational radiation dose will be kept to zero if
  - a. careful technique is employed
  - b. the office is well designed
  - c. the office is well monitored
  - d. the office is well equipped
  - e. All of the above are correct.
3. The MPD is best defined as
  - a. the maximum dose of radiation a patient should receive from dental exposures
  - b. the permissible amount of radiation that causes cancer in human populations
  - c. the maximum dose of ionizing radiation that is not expected to cause injury
  - d. the amount of radiation that kills 50% of a population in 30 days
  - e. none of the above
4. By having the operator stand 6 feet rather than 3 feet from a radiation source, the resultant exposure is decreased by a factor of
  - a. 2
  - b. 4
  - c. 6
  - d. 8
  - e. 10
5. The International Commission on Radiation Protection (ICRP) has recommended that the yearly MPD for operators not exceed
  - a. 5 mrem
  - b. 500mrem
  - c. 50mrem
  - d. 5000mrem
  - e. 5.5 mrem
6. Workload determination for dental x-ray machine room barriers requires knowledge of
  - a. milliamperage
  - b. exposure time per film
  - c. number of exposures per week
  - d. adjacent room location
  - e. experience of operator
  - (1) a, d, e
  - (2) a, b, c
  - (3) a, b, c, d
  - (4) c, d, e
  - (5) a, c, d, e
7. What can be used to check the reliability of the x-ray machine and protective barriers?
  - a. film badge
  - b. ionizing chamber
  - c. pocket dosimeter
  - d. coin test
  - e. a, b, and c only
8. Which of the following is true regarding film badges?
  - a. They should be worn when dental personnel have radiographs as a patient.
  - b. Film badges can be shared by employees.
  - c. Film badges can be worn outside the office.
  - d. Film badges should be worn so as not to be blocked by pens or jewelry.
  - e. None of the above is correct.



9. Which of the following, if sufficient, could provide adequate shielding?
- lead-lined walls
  - dry wall construction
  - cinder block walls
  - concrete walls
  - All of the above could be adequate.
10. What is the main source of radiation exposure to the operator?
- primary radiation
  - scatter radiation
  - background radiation
  - tertiary radiation
  - none of the above

## VII. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

- Operators of dental x-ray machines should be 4 feet away from the source of radiation. **T/F**
- Lead-lined walls in a dental operatory are not mandatory. **T/F**
- Film badges are always required in a dental office. **T/F**
- The MPD for occupationally exposed individuals in the dental office per week is 100 mrem. **T/F**
- Selection criteria are guidelines established to mandate barrier protection in the operatory. **T/F**

# Film Processing: The Darkroom

## Educational Objectives

*After reading Chapter 8 of the textbook and completing this exercise, the student will*

1. Understand the theory of film processing and how to operate and maintain a darkroom.
2. Be able to process radiographs and identify and correct errors made in the darkroom.

## I. Definitions

Define/explain the following terms.

1. Archival life \_\_\_\_\_  
\_\_\_\_\_
2. Automatic processing \_\_\_\_\_  
\_\_\_\_\_
3. Clear film \_\_\_\_\_  
\_\_\_\_\_
4. Coin test \_\_\_\_\_  
\_\_\_\_\_
5. Darkroom \_\_\_\_\_  
\_\_\_\_\_
6. Daylight loader \_\_\_\_\_  
\_\_\_\_\_
7. Developer cutoff \_\_\_\_\_  
\_\_\_\_\_
8. Film fog \_\_\_\_\_  
\_\_\_\_\_
9. Film hangers \_\_\_\_\_  
\_\_\_\_\_

10. Latent image \_\_\_\_\_  
\_\_\_\_\_
11. Manual processing \_\_\_\_\_  
\_\_\_\_\_
12. Rapid processing \_\_\_\_\_  
\_\_\_\_\_
13. Reference film \_\_\_\_\_  
\_\_\_\_\_
14. Replenisher solutions \_\_\_\_\_  
\_\_\_\_\_
15. Safelight \_\_\_\_\_  
\_\_\_\_\_
16. Sight developing \_\_\_\_\_  
\_\_\_\_\_
17. Silver retrieval \_\_\_\_\_  
\_\_\_\_\_
18. Thermostatic valve \_\_\_\_\_  
\_\_\_\_\_
19. Time-temperature processing \_\_\_\_\_  
\_\_\_\_\_
20. Wet reading \_\_\_\_\_  
\_\_\_\_\_

## II. Comprehension Exercise

1. List, describe, and state the purpose of each step involved in the manual processing of dental x-ray film.
  
  
  
  
  
  
  
  
  
  
2. What is the primary precaution that should be taken when processing extraoral radiographs? Why?

3. How do you test for safelight reliability?
4. Why is the time-temperature technique the best method for processing radiographs?
5. List and explain the three types of wastes that can be generated as a result of dental radiography.
6. Is sight developing an acceptable technique? Why or why not?
7. Why is it not acceptable to underdevelop a film to compensate for overexposure of the same film?
8. What is the major advantage of automatic processing? Explain.

9. List the chemicals that make up the developer and fixer solutions and identify the function of each.
10. What are the clinical indications for rapid processing? What are the disadvantages?
11. List two ways to check the strength of the processing solutions as a component of the quality assurance program and explain each method.
12. When must safelight conditions be maintained in the darkroom?
13. What are the responsibilities of the dental support team in the darkroom?
14. Define reticulation and describe the cause and remedy related to this processing error.

15. Distinguish between the appearance of collimator cutoff and developer cutoff on the finished radiograph.
16. Can one distinguish between an overexposed film and an overdeveloped film? How?
17. What can cause a clear film?
18. Discuss the importance of a quality assurance program in the darkroom.
19. When should processing solutions be changed?
20. What causes white lines on a finished radiograph? Black lines?
21. What will happen if film is left in the fixer solution over a weekend?

22. What should you do if succeeding panoramic films appear increasingly light?
23. Why is it important to maintain the levels of the processing solutions? How often should the levels be checked? What should be done to maintain the adequate levels?
24. What are the factors that should be considered when determining the space needed for a darkroom?
25. Name the five different light sources in a well-designed darkroom and provide the purpose for each.

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

#### *Column A*

- \_\_\_\_\_ 1. coin test
- \_\_\_\_\_ 2. lost films in tank
- \_\_\_\_\_ 3. underdeveloped film
- \_\_\_\_\_ 4. static marks
- \_\_\_\_\_ 5. excessive fixing
- \_\_\_\_\_ 6. overdeveloped film
- \_\_\_\_\_ 7. energized silver bromide
- \_\_\_\_\_ 8. radiolucent bands on film
- \_\_\_\_\_ 9. sodium carbonate
- \_\_\_\_\_ 10. thermometer
- \_\_\_\_\_ 11. air bubbles
- \_\_\_\_\_ 12. unaffected silver bromide
- \_\_\_\_\_ 13. energized silver
- \_\_\_\_\_ 14. overlapped films
- \_\_\_\_\_ 15. change solutions

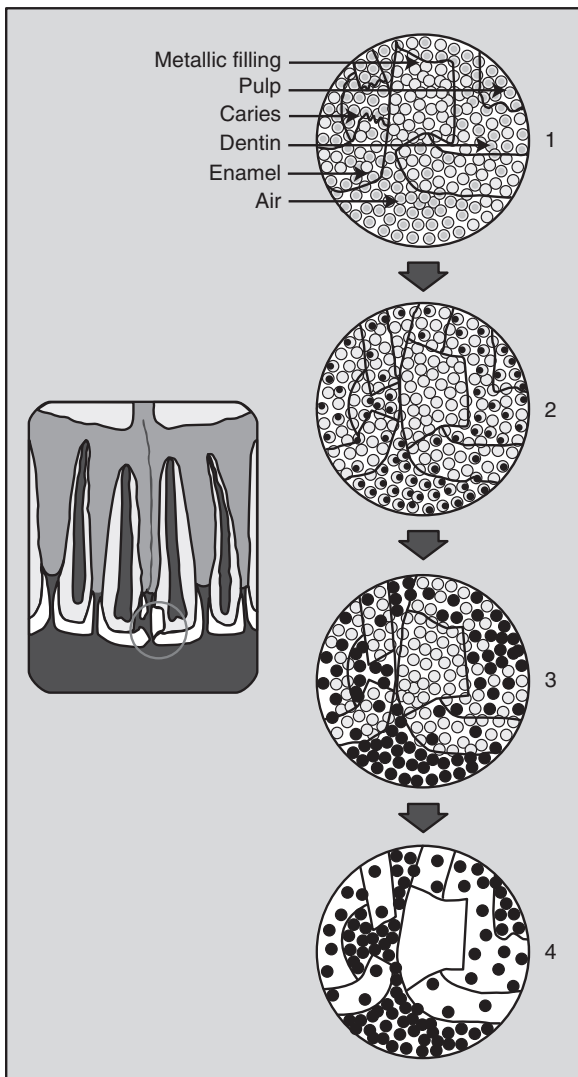
#### *Column B*

- a. latent image
- b. agitate film hangers
- c. dense image
- d. 2 to 3 weeks
- e. softens gelatin
- f. films fed too quickly
- g. hardens gelatin crystals
- h. clear films
- i. thin image
- j. safelight check
- k. dirty rollers
- l. "wet elbow"
- m. fixer precipitated
- n. forcefully open packet
- o. developer
- p. reticulation
- q. kept in the developer



## IV. Illustrations

1. (Figure 8-1) What stages of the developing process are seen diagrammatically in this figure (1, 2, 3 and 4)?



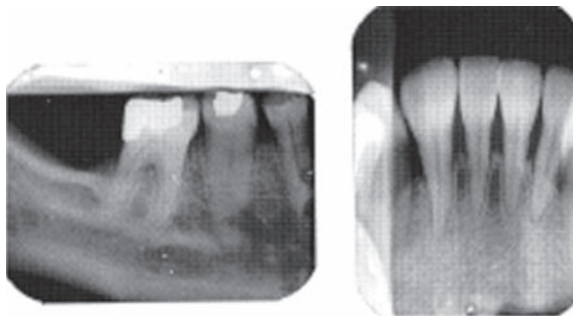
1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_

2. (Figure 8-2) List two possible causes for the film fog seen in this figure.



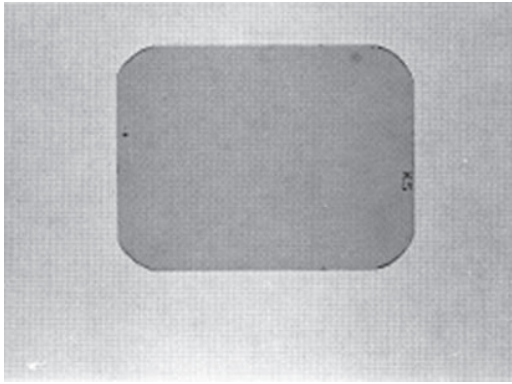
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

3. (Figure 8-3) Identify the error seen in this figure.



- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

4. (Figure 8-4) Name three possible causes that could produce a film like that seen in this figure.

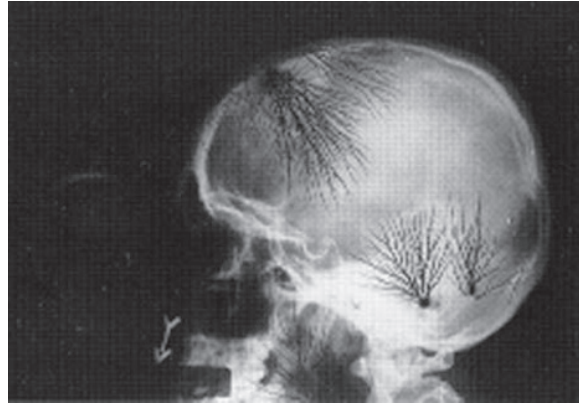


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6. (Figure 8-6) What error results in the artifacts seen in this figure?

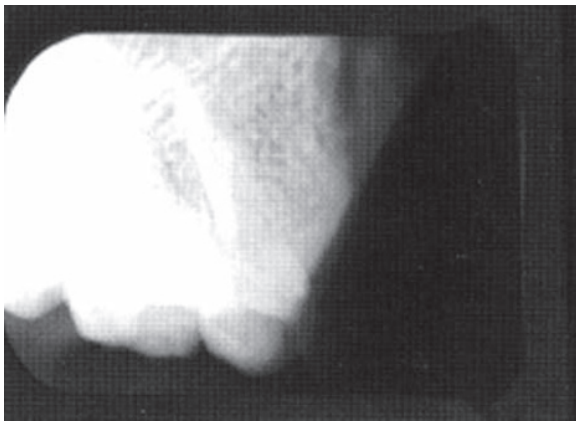


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5. (Figure 8-5 ) What could cause the error seen in this figure?



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7. (Figure 8-7) What error was made in automatic processing to result in this figure?



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8. (Figure 8-8) What error produces the film seen in this figure?

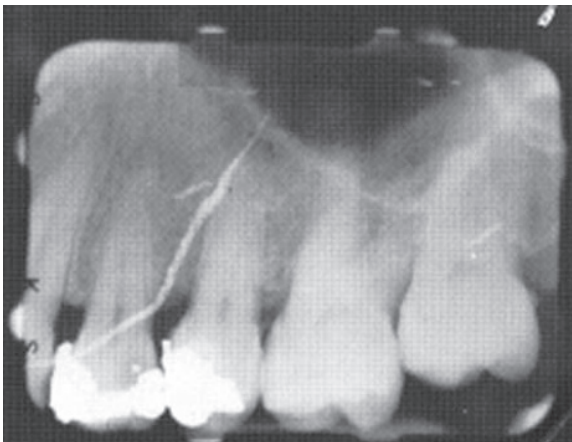



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9. (Figure 8-9) What error can produce a radiograph such as the one in this figure?

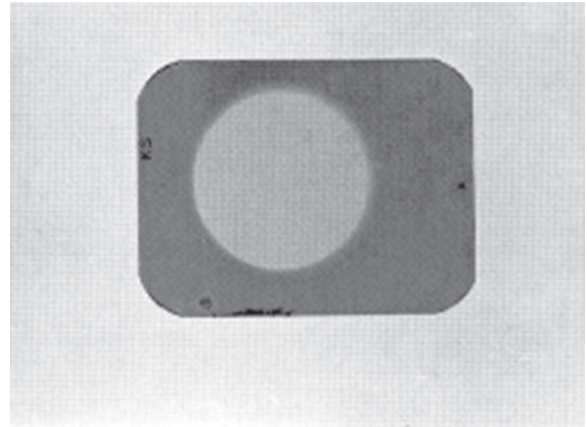



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10. (Figure 8-10) Interpret the result of the safelight (coin) test shown in this figure.




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## V. Complete These Statements

1. The temperature of the processing chemicals is maintained by  
\_\_\_\_\_  
\_\_\_\_\_.
2. If the developer solution contaminates the fixer solution, the operator should  
\_\_\_\_\_.
3. Two types of light used in the darkroom are \_\_\_\_\_ and  
\_\_\_\_\_.
4. Two advantages of automatic processors are \_\_\_\_\_ and  
\_\_\_\_\_.
5. A latent image is invisible until the film is  
\_\_\_\_\_.
6. The easiest way to check a darkroom for light leaks is to  
\_\_\_\_\_  
\_\_\_\_\_.

7. At minimum, developer and fixer levels should be checked \_\_\_\_\_.
8. A manually processed radiograph should be washed for \_\_\_\_\_ just before drying.
9. The thermometer in a darkroom is always kept in the \_\_\_\_\_ solution.
10. The levels of the processing chemicals should be maintained by adding \_\_\_\_\_.
11. Expended fixer solution should be disposed of by \_\_\_\_\_.
12. To determine whether a safelight is "safe," one should \_\_\_\_\_.
13. X-ray processing solutions should be stored in a \_\_\_\_\_, \_\_\_\_\_ area.
14. For complete fixation, the films should be left in the solution for approximately \_\_\_\_\_ the developing time.
15. Panoramic films are processed in \_\_\_\_\_ as intraoral films.
2. A major difference between automatic and manual processing of radiographs is that automatic processing
  - a. is more expensive
  - b. provides better quality films
  - c. requires special solutions at higher temperatures
  - d. doesn't allow for processing errors
  - e. allows for more latitude in exposure techniques
3. In developing radiographs, the fixer acts to
  - a. prevent film fog and soften the emulsion
  - b. remove exposed silver halide and soften the emulsion
  - c. remove exposed silver halide and shrink and harden the emulsion
  - d. remove unexposed and undeveloped silver halide from the film and harden the emulsion
  - e. prevent reticulation and harden the emulsion
4. If the temperature of the processing solutions is slightly above normal, radiographs of desired density may be best obtained by
  - a. increasing the fixing time
  - b. decreasing the fixing time
  - c. increasing the developing time
  - d. decreasing the developing time
  - e. increasing the exposure time
5. A latent image is
  - a. found only on E-speed film
  - b. caused only by scattered radiation
  - c. prevented by the lead foil in the film packet
  - d. invisible until the film is processed
  - e. none of the above
6. An exposed radiograph should remain in the fixer in order to attain archival life for
  - a. as long as it remains in the developer
  - b. until the film clears
  - c. twice the developing time
  - d. a minimum of 1 hour
  - e. 5 minutes at 70°F

## VI. Multiple Choice

1. Each successive full-mouth survey appears lighter than the one before. Which of the following corrections should be made?
  - a. Increase the mA setting.
  - b. Increase the kVp setting.
  - c. Change the intensifying screens.
  - d. Change the developer solution.
  - e. Decrease the temperature of the developer solution.
2. A major difference between automatic and manual processing of radiographs is that automatic processing
  - a. is more expensive
  - b. provides better quality films
  - c. requires special solutions at higher temperatures
  - d. doesn't allow for processing errors
  - e. allows for more latitude in exposure techniques
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  - c. remove exposed silver halide and shrink and harden the emulsion
  - d. remove unexposed and undeveloped silver halide from the film and harden the emulsion
  - e. prevent reticulation and harden the emulsion
4. If the temperature of the processing solutions is slightly above normal, radiographs of desired density may be best obtained by
  - a. increasing the fixing time
  - b. decreasing the fixing time
  - c. increasing the developing time
  - d. decreasing the developing time
  - e. increasing the exposure time
5. A latent image is
  - a. found only on E-speed film
  - b. caused only by scattered radiation
  - c. prevented by the lead foil in the film packet
  - d. invisible until the film is processed
  - e. none of the above
6. An exposed radiograph should remain in the fixer in order to attain archival life for
  - a. as long as it remains in the developer
  - b. until the film clears
  - c. twice the developing time
  - d. a minimum of 1 hour
  - e. 5 minutes at 70°F

7. Which of the following causes dark spots during film development?
  - a. film contamination with fixer before processing
  - b. film contamination with developer before processing
  - c. developing solution that is too warm
  - d. overdevelopment of the exposed film
  - e. none of the above
8. The effect of safelight illumination in the darkroom does not depend on which of the following?
  - a. size of the darkroom
  - b. type of film used
  - c. wattage of the bulb
  - d. type of filter used
  - e. distance of the safelight from the work surface
9. A radiograph is clear after processing. This could result from any of the following *except*
  - a. unexposed film
  - b. excessive washing
  - c. prolonged fixing
  - d. exposure to white light
  - e. the x-ray machine was not turned on
10. In treating an emergency patient you remove the radiograph from the fixer bath after 3 minutes and wash it. It is diagnostic. After treatment the film is dried and put in the patient's chart.
  - a. This is proper procedure.
  - b. This is acceptable procedure.
  - c. The film will turn yellowish-brown in a few weeks.
  - d. The film should have been returned to the water bath overnight.
  - e. None of the above is true.
11. The operator observes that a portion of the processed panoramic radiograph is completely black. What is the most likely cause?
  - a. excessive exposure time
  - b. exposure to white light
  - c. exposure to a light leak
  - d. temperature of the developer was too high
  - e. patient movement occurred during exposure
12. In the time-temperature method of processing dental radiographs, the thermometer is
  - a. not used
  - b. kept in the fixer bath
  - c. kept in the water bath
  - d. kept in the developer bath
  - e. not read for the first series processed
13. Which is the correct order for manually processing radiographs?
  - a. rinse, develop, fix
  - b. develop, fix, wash, dry
  - c. develop, rinse, fix, wash, dry
  - d. fix, rinse, develop, wash, dry
  - e. None of the above is correct.
14. Even though proper exposure techniques were employed, radiographs emerging from an automatic processor exhibit chalky smudges. What is the most likely cause?
  - a. improper safelighting
  - b. use of outdated film
  - c. premature contact with the developer solution
  - d. premature contact with the fixer solution
  - e. dirty processor rollers



15. Manufacturers recommend that radiographic developing solutions be covered to prevent
  - a. evaporation of the solutions
  - b. an increase in the strength of the solutions
  - c. emission of an oxidizing agent
  - d. dilution of the solutions
  - e. both a and c are acceptable answers
16. The coin test of a safelight in the darkroom shows a clear outline of the coin. What does this mean?
  - a. The developer is exhausted.
  - b. The safelight is adequate.
  - c. The fixer solution is weak.
  - d. The safelight is faulty.
  - e. There was inadequate fixation.
17. If films are fed into the automatic processor too rapidly, what can happen?
  - a. Films will stick together.
  - b. Films will be cracked.
  - c. Static electricity will be generated.
  - d. Radiographs will be lighter than normal.
  - e. Radiographs will be darker than normal.
18. A step-wedge control device would be primarily used
  - a. to test the safelight in the darkroom
  - b. to evaluate the amount of radiation exposure
  - c. to wedge steps of lead into the dental walls to act as a barrier to radiation
  - d. for quality assurance of processing solutions
  - e. to compare the dental films of one patient to another
19. Which of the following conditions will result in a radiograph that is too light?
  - a. The darkroom door is left opened during developing.
  - b. Processing solutions are too warm.
  - c. The safelight is inadequate.
  - d. The automatic processor has a daylight loader.
  - e. The developing solution is too weak.
20. Which of the following does not cause film fog in developed radiographs?
  - a. underexposure
  - b. scatter radiation
  - c. improper safelighting
  - d. a light leak in the darkroom
  - e. processing solutions that are too warm
21. After developing a complete radiographic series, the operator notices that the films on the bottom of the rack are of a different density than those at the top of the rack and concludes that
  - a. the developing solution was contaminated
  - b. the thermometer is faulty
  - c. the fixer solution was reaching exhaustion
  - d. the solutions were not stirred
  - e. the developing solution was too cold
22. Your last patient before the weekend is a new patient on whom you take a full-mouth series of radiographs. If you process the films that evening,
  - a. the films can be left in the water bath
  - b. the films can be left in the fixer
  - c. the films have to be processed immediately to preserve the latent image
  - d. the films can be left in the developer
  - e. the films must be processed completely and left to dry
23. One indication for "rapid processing" would be
  - a. detection of caries
  - b. periodontal bone evaluation
  - c. confirming an endodontic measurement
  - d. evaluating periapical changes
  - e. none of the above

24. The action of the fixer on unenergized silver bromide crystals in the emulsion is to
- precipitate them as free silver
  - fix them to the film base
  - incorporate them into the hardened gelatin
  - remove them from the film
  - reuse them
25. Processing solutions should be changed, depending on usage, about
- every week
  - every day
  - every month
  - every 2 to 3 weeks
  - every 6 months

## VII. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

- Automatic processing is never recommended over manual processing. **T/F**
- When processing solutions are at a low level, water should be added. **T/F**
- Expendable fixing solutions should be poured down the drain. **T/F**
- Sight development is a scientifically acceptable procedure of processing. **T/F**
- The coin test is used to test the level of solutions in the processing tanks. **T/F**

# Infection Control in Dental Practice

## Educational Objectives

*After reading Chapter 9 of the textbook and completing this exercise, the student will*

1. Be able to take and process all radiographs, adhering to and understanding the accepted infection control policy.
2. Be able to prepare and break down a dental operator after completing patient radiographs.
3. Feel comfortable and assured in treating a patient with an infectious disease by following infection control protocol.

## I. Definitions

Define/explain the following terms.

1. AIDS \_\_\_\_\_  
\_\_\_\_\_
2. Antibiotic prophylaxis \_\_\_\_\_  
\_\_\_\_\_
3. CDC \_\_\_\_\_  
\_\_\_\_\_
4. Cold sterilization \_\_\_\_\_  
\_\_\_\_\_
5. Contamination \_\_\_\_\_  
\_\_\_\_\_
6. Critical instruments \_\_\_\_\_  
\_\_\_\_\_
7. Cross-contamination \_\_\_\_\_  
\_\_\_\_\_
8. Disinfection \_\_\_\_\_  
\_\_\_\_\_
9. Immunization \_\_\_\_\_  
\_\_\_\_\_



10. Infection control barriers \_\_\_\_\_  
\_\_\_\_\_
11. OSHA \_\_\_\_\_  
\_\_\_\_\_
12. Parental exposure \_\_\_\_\_  
\_\_\_\_\_
13. Pathogen \_\_\_\_\_  
\_\_\_\_\_
14. Sterilization \_\_\_\_\_  
\_\_\_\_\_
15. Universal precautions \_\_\_\_\_  
\_\_\_\_\_

## II. Comprehension Exercise

1. In dental radiography what are the main vectors for cross-contamination?
  
  
  
  
  
  
  
  
  
  
2. What is the significance of taking a comprehensive medical history on a patient before dental treatment?
  
  
  
  
  
  
  
  
  
  
3. What are the required barriers that dental personnel must wear while performing radiographic procedures?

4. What are some of the barriers that can be used for equipment in the operatory when performing radiography?
5. Why is saliva considered to be a possible transmission route for human immunodeficiency virus (HIV) even though transmission via this route has not been documented to date?
6. What is the difference between sterilization and disinfection? How is each used in dental radiology?
7. For which diseases should dental personnel receive immunizations?
8. Describe the use of the processing solutions used in the darkroom in terms of the disinfection and sterilization of the film.
9. What are the infection control requirements concerning protective clothing in dentistry?

10. What are the cross-contamination hazards with the use of a daylight loader?
11. List the infection control procedures that operators should follow before, during, and after the taking of dental radiographs.
12. What is the general consensus regarding antibiotic prophylaxis and dental radiographic procedures?
13. Describe three ways to handle contaminated film packets to avoid contaminating the film.
14. What is a barrier film packet? Describe its use.
15. What type of infection control procedures is necessary when using an automatic processor with a daylight loader? Without a daylight loader?

16. What is “cold sterilization”? Is it appropriate for use in dental radiography?
17. What is the problem in using disinfecting solutions instead of barriers with the dental x-ray machine?
18. Discuss the disadvantages of using gloves, mask, and eyewear when performing dental radiographic procedures.
19. What are the infection control procedures needed when taking a panoramic radiograph?
20. Explain the following statement and its clinical significance: “All pathogens are microorganisms, but not all microorganisms are pathogens.”

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

*Column A*

- \_\_\_\_\_ 1. AIDS
- \_\_\_\_\_ 2. immunization
- \_\_\_\_\_ 3. pathogen
- \_\_\_\_\_ 4. barriers
- \_\_\_\_\_ 5. disinfecting solution
- \_\_\_\_\_ 6. sterilization
- \_\_\_\_\_ 7. cold sterilization
- \_\_\_\_\_ 8. antiseptic agent
- \_\_\_\_\_ 9. barrier envelope
- \_\_\_\_\_ 10. saliva
- \_\_\_\_\_ 11. previous endocarditis
- \_\_\_\_\_ 12. semicritical instrument
- \_\_\_\_\_ 13. critical instrument
- \_\_\_\_\_ 14. occupational exposure
- \_\_\_\_\_ 15. film packet

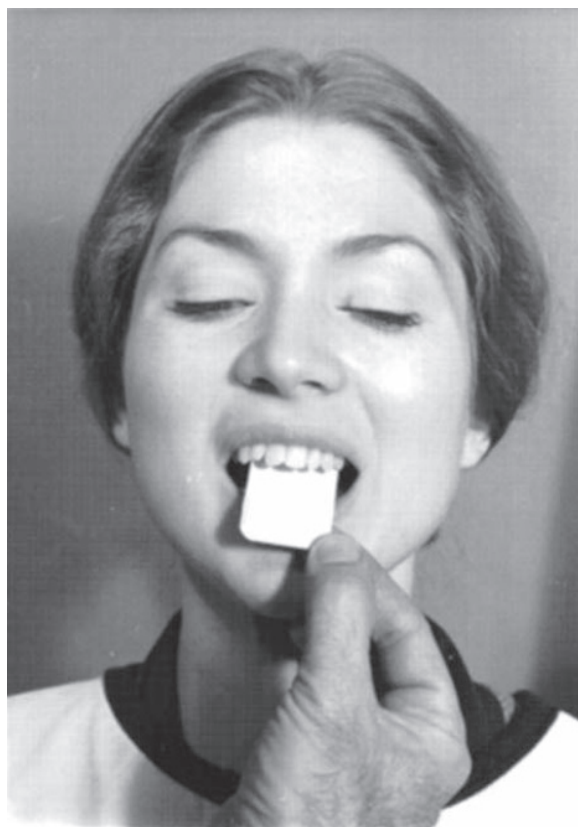
*Column B*

- a. film
- b. main vector
- c. antibiotic prophylaxis
- d. no vaccine
- e. hepatitis B
- f. contaminant
- g. protects film
- h. patient's chart
- i. soap
- j. periodontal probe
- k. gloves, mask, eyewear, gowns
- l. steam autoclave
- m. iodophor
- n. film-holding device
- o. not recommended
- p. causes disease

## IV. Illustrations

Identify the errors illustrated in Figures 9-1 through 9-5.

1. (Figure 9-1)



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2. (Figure 9-2)



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3. (Figure 9-3)

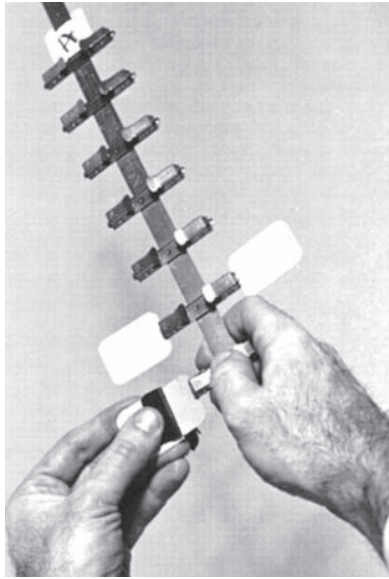


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4. (Figure 9-4)



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5. (Figure 9-5)



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## V. Complete These Statements

1. Even before the advent of AIDS, \_\_\_\_\_ and \_\_\_\_\_ had always been a risk for dental professionals.
2. \_\_\_\_\_ is the most common and easily recognized transmission route of HIV, HBV, and HCV.
3. AIDS and HIV are abbreviations for \_\_\_\_\_ and \_\_\_\_\_.
4. When taking intraoral radiographs, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_ should be worn at all times.
5. All dental professionals should be immunized for \_\_\_\_\_.
6. The most common methods of sterilization used in the dental office are \_\_\_\_\_ and the use of the \_\_\_\_\_.
7. Infection control procedures require that every patient be treated \_\_\_\_\_.
8. Three vehicles for the transmission of pathogens on intraoral film holders are \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.

9. Other than the operator's hands, the \_\_\_\_\_ is considered to be the main source of cross-contamination in dental radiography.
10. Anything that the operator touches after removing the exposed film packet from the patient's mouth must be considered \_\_\_\_\_.
11. All working surfaces and the dental x-ray unit should be \_\_\_\_\_ before radiographs are taken.
12. Cold sterilization is \_\_\_\_\_ an acceptable method for use for intraoral film-holding devices.
13. \_\_\_\_\_ can be contaminated by blood and therefore poses a potential for transmission of infectious organisms.
14. Film packets are considered \_\_\_\_\_ after they are removed from the patient's mouth.
15. The developing and fixing solutions used in the darkroom have not been shown to act as \_\_\_\_\_ agents.
2. If the barrier envelope is not used
  - a. operators could open the packet without gloves.
  - b. operators should remove the films while wearing the same gloves used for exposure.
  - c. operators should take care not to touch the films as they are dropped onto a clean surface
  - d. operators could touch anything on the way to the darkroom with the previously contaminated gloves.
  - e. none of the above
3. Daylight loaders are not recommended for infection control because of
  - a. strength of the processing solutions
  - b. time delay
  - c. possibility of cross-contamination within the confined area of the loader
  - d. light leaks
  - e. none of the above
4. Infection control procedures should be followed for
  - a. patients known to have AIDS
  - b. patients who are HIV positive
  - c. patients with an alternative lifestyle
  - d. all patients
  - e. non-compliant patients
5. Any contaminated film that is processed
  - a. emerges from the processor sterilized
  - b. emerges from the processor disinfected
  - c. emerges from the processor decontaminated
  - d. emerges from the processor still contaminated
  - e. none of the above

---

## VI. Multiple Choice

Select the best answer.

1. In dental radiography, which of the following infection control procedures is used?
  - a. sterilization
  - b. disinfection
  - c. antiseptic agents
  - d. instant hand sanitizer
  - e. all of the above
6. With the use of a barrier envelope
  - a. no other precautions are necessary
  - b. gloves are not necessary after the film has been removed from the packs
  - c. processing is less difficult
  - d. processing is more difficult
  - e. an increased exposure time is needed



7. Developer and fixer solutions
  - a. do not act as sterilizing agents
  - b. are antiseptic
  - c. act as sterilizing agents
  - d. destroy all viruses
  - e. none of the above
8. Autoclaving a contaminated exposed film packet
  - a. is not recommended because it takes too long
  - b. does not sterilize the packet
  - c. destroys the image
  - d. refines the image
  - e. none of the above
9. Every patient should have a current medical history that
  - a. is obtained through a questionnaire
  - b. is obtained through direct questioning
  - c. alerts the dental team to the presence or history of infectious disease
  - d. All of the above are valid statements.
  - e. None of the above are valid statements.
10. Immersing the contaminated exposed film packet in a disinfecting solution
  - a. destroys the image
  - b. is recommended
  - c. takes too long
  - d. none of the above
  - e. all of the above
11. Using disinfecting solutions on the dental x-ray unit is not recommended because
  - a. of the cost involved
  - b. of the time involved
  - c. it is not effective
  - d. the solution may seep into the electrical connections
  - e. none of the above
12. Microorganisms can remain viable on radiographic equipment for at least
  - a. 72 hours
  - b. 48 hours
  - c. 10 hours
  - d. 24 hours
  - e. none of the above
13. When taking bitewings on a patient with a negative medical history
  - a. gloves and eyewear should be used
  - b. just gloves are necessary
  - c. gloves, eyeglasses, protective clothing, and masks should be worn
  - d. eyeglasses are not necessary
  - e. none of the above
14. When taking a full-mouth series of radiographs
  - a. the exposure switch should be covered with plastic
  - b. the PID need not be covered if gloves are worn
  - c. a film dispenser should not be used
  - d. unexposed film should be kept in the room
  - e. none of the above
15. The infection control procedure for daylight loaders includes
  - a. preparing the interior of the daylight loader before processing
  - b. placing clean hands through the sleeve baffles
  - c. opening packets with clean gloves
  - d. All of the above are true statements.
  - e. None of the above are true statements.

## VII. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

1. An antiseptic is a substance that inhibits the growth of bacteria. **T/F**
2. Sterilization is the process of destroying disease-causing microorganisms by physical or chemical means. **T/F**
3. Every patient should not be treated in the same manner such as with universal precautions. **T/F**
4. The processing procedure for films with and without barrier envelopes is exactly the same. **T/F**
5. In panoramic radiography more areas are contaminated by the patient's saliva. **T/F**

# Intraoral Technique: The Paralleling Method

## Educational Objectives

*After reading Chapter 10 of the textbook and completing this exercise, the student will*

1. Understand the geometry of the x-ray beam direction and film placement.
2. Be able to apply these principles to take a full-mouth survey of radiographs for dentulous and edentulous adult or pediatric patients.
3. Recognize unacceptable radiographs and their causes and know how to correct the errors.

## I. Definitions

Define/explain the following terms.

1. Bitewing radiograph \_\_\_\_\_  
\_\_\_\_\_
2. Blurred image \_\_\_\_\_  
\_\_\_\_\_
3. Collimator cutoff \_\_\_\_\_  
\_\_\_\_\_
4. Dimensional accuracy \_\_\_\_\_  
\_\_\_\_\_
5. Double exposure \_\_\_\_\_  
\_\_\_\_\_
6. Exposure time \_\_\_\_\_  
\_\_\_\_\_
7. Film reversal \_\_\_\_\_  
\_\_\_\_\_
8. Full-mouth survey (series) \_\_\_\_\_  
\_\_\_\_\_
9. Horizontal angulation \_\_\_\_\_  
\_\_\_\_\_

10. Localizing ring \_\_\_\_\_  
\_\_\_\_\_
11. Overexposure \_\_\_\_\_  
\_\_\_\_\_
12. Overlapping \_\_\_\_\_  
\_\_\_\_\_
13. Paralleling method \_\_\_\_\_  
\_\_\_\_\_
14. Pediatric full-mouth survey (series) \_\_\_\_\_  
\_\_\_\_\_
15. Periapical radiograph \_\_\_\_\_  
\_\_\_\_\_
16. Point of entry \_\_\_\_\_  
\_\_\_\_\_
17. Sagittal plane orientation \_\_\_\_\_  
\_\_\_\_\_
18. Underexposure \_\_\_\_\_  
\_\_\_\_\_
19. Vertical angulation \_\_\_\_\_  
\_\_\_\_\_
20. Vertical bitewing radiograph \_\_\_\_\_  
\_\_\_\_\_

## II. Comprehension Exercise

1. Explain why it is necessary in a full-mouth series to take radiographs of edentulous areas.
  
  
  
  
  
  
  
  
  
  
2. What would be the indication for use of vertical bitewing projections?

3. Describe what an elongated radiograph looks like.
4. What is the importance of correct horizontal angulation?
5. List/explain two helpful hints for placement of the mandibular anterior projection.
6. What are the two main principles of the paralleling method?
7. What is the purpose of using a localizing ring?
8. Describe the film position for a maxillary molar projection.
9. How does the consequence of inadequate closure appear on a radiograph?

10. Describe what a foreshortened radiograph would look like.
11. Why does one remove nonfixed appliances from the patient's mouth when taking radiographs?
12. What can cause a blurred image?
13. Name three chairside technique errors that will result in a thin (light) film.
14. How does a cracked emulsion due to overbending the film packet appear on the radiograph?
15. List the criteria that determine whether a radiograph is considered diagnostic.

16. Why is there no superimposition of the zygomatic arch on maxillary molars in the paralleling technique?
17. Can the paralleling method be used with an 8-inch focal-film distance (FFD)? Explain.
18. What determines how many films there will be in a pediatric full-mouth survey?
19. List/describe one way to avoid double-exposed projections.
20. What action would you take before using the bisecting angle technique if parallel positioning of the film is difficult on a pediatric patient?

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

#### *Column A*

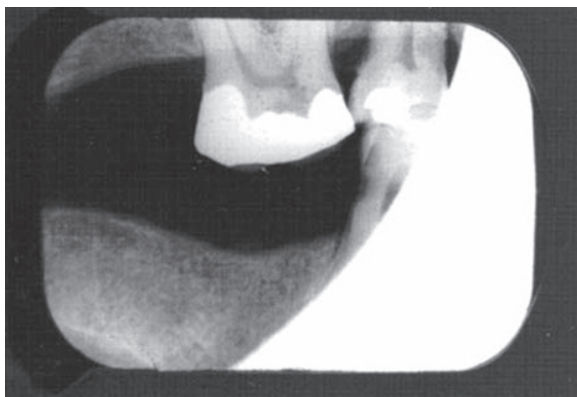
- \_\_\_\_\_ 1. proximal surface overlap
- \_\_\_\_\_ 2. collimator cutoff
- \_\_\_\_\_ 3. dense film
- \_\_\_\_\_ 4. "herringbone" effect
- \_\_\_\_\_ 5. thin image (light)
- \_\_\_\_\_ 6. localizing ring
- \_\_\_\_\_ 7. elongation
- \_\_\_\_\_ 8. bitewing projection
- \_\_\_\_\_ 9. residual pathology
- \_\_\_\_\_ 10. loss of definition
- \_\_\_\_\_ 11. bisecting angle technique
- \_\_\_\_\_ 12. 16-inch PID
- \_\_\_\_\_ 13. inadequate vertical angulation
- \_\_\_\_\_ 14. premolar projection
- \_\_\_\_\_ 15. excessive vertical angulation

#### *Column B*

- a. patient movement
- b. overexposure
- c. dimensional distortion
- d. elongation
- e. long cone technique
- f. distal of the canine
- g. beam-film alignment
- h. film of edentulous area
- i. foreshortening
- j. inadequate milliamperage
- k. film reversal
- l. unexposed film area
- m. vertical angulation
- n. patient tolerance
- o. horizontal angulation
- p. interproximal caries detection
- q. identification dot

### IV. Illustrations

1. (Figure 10-1) What error is illustrated here?  
How would you correct it?




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2. (Figure 10-2) What error is illustrated here?  
How would you correct it?




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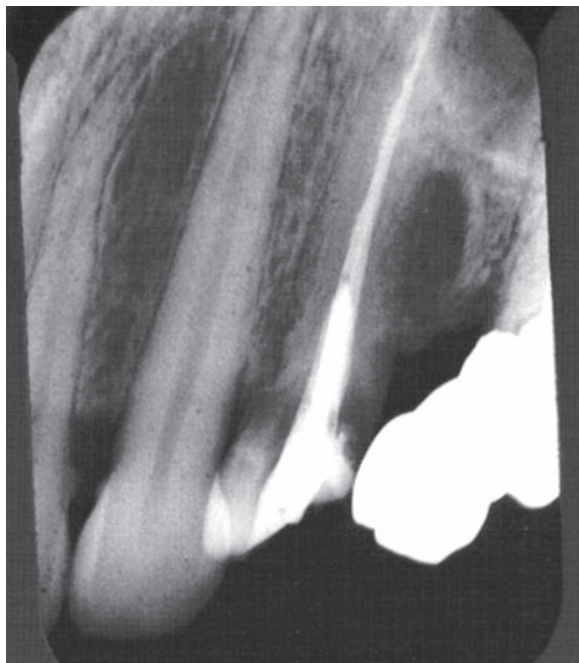


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3. (Figure 10-3) What error is illustrated here?  
How would you correct it?

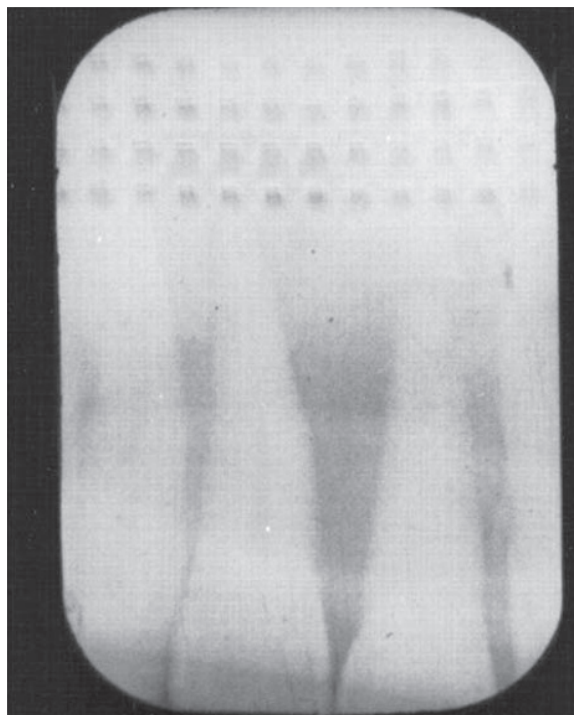


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4. (Figure 10-4) What error is illustrated here?  
What would you do to prevent its repetition?



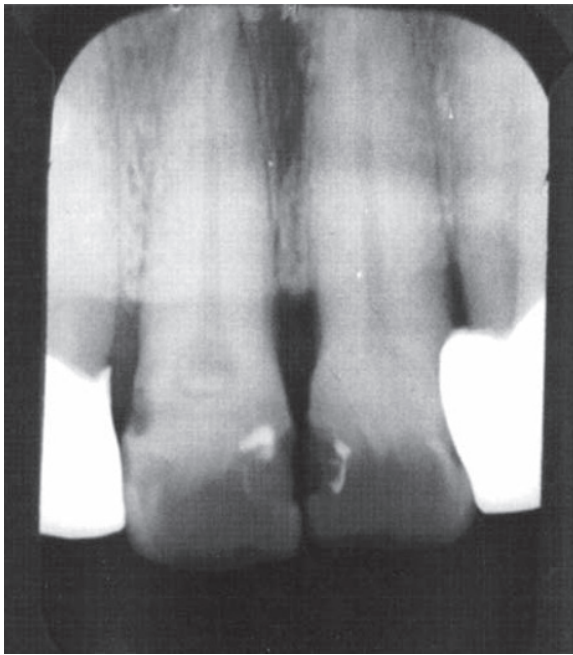
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5. (Figure 10-5) What error is illustrated here? What would you do to prevent its repetition?



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6. (Figure 10-6) List four possible technique errors that would result in the image shown here.



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7. (Figure 10-7) What chairside errors could result in the following film?



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## V. Complete These Statements

1. In using the paralleling method, the most appropriate FFD is \_\_\_\_\_.
2. An example of a film holder for intraoral periapical radiography is a \_\_\_\_\_ or \_\_\_\_\_.
3. \_\_\_\_\_ is determined by the area being radiographed, film speed, kilovoltage peak, milliamperage, and FFD.
4. Bitewing radiographs do not show the \_\_\_\_\_.
5. A black, crescent-shaped mark on a radiograph is an indication of \_\_\_\_\_.
6. The occlusal plane of the jaw being radiographed should be \_\_\_\_\_ to the floor.
7. The location on the patient's face that corresponds to the center of the film is called the \_\_\_\_\_.
8. Failure to align the x-ray beam with the film packet will result in \_\_\_\_\_.
9. If the film packet is curved to accommodate the shape of the palate, it should be curved \_\_\_\_\_ the source of radiation.
10. Another name for the paralleling method is \_\_\_\_\_.
11. The sagittal plane of the patient's face always should be \_\_\_\_\_.
12. The film packet should be placed \_\_\_\_\_ to both the vertical and horizontal axis of the tooth being radiographed.
13. When taking a full-mouth series, partial dentures always should be \_\_\_\_\_ to avoid superimposition.
14. Increasing the FFD without changing the milliamperage will result in a \_\_\_\_\_.
15. The most common error in the paralleling technique is in \_\_\_\_\_.

## VI. Multiple Choice

Select the best answer.

1. A reason for using the paralleling method instead of the bisecting method is
  - a. less thyroid dose to the patient
  - b. less dimensional distortion
  - c. less exit dose
  - d. no superimposition of the zygomatic arch
  - e. all of the above
2. Bitewing radiographs are used to detect
  - a. periodontal bone loss
  - b. interproximal caries
  - c. recurrent caries
  - d. the ill-fit of metallic restorations
  - e. all of the above
3. In taking the radiograph you did not center the beam on the film packet in the patient's mouth. The resulting film will show
  - a. fogging
  - b. overlapping
  - c. elongation
  - d. collimator cutoff
  - e. foreshortening

4. A set of radiographs all show thin images. One possible error that could have caused this is
  - a. the developing solution is too hot
  - b. excessive milliamperere seconds
  - c. excessive kilovoltage peak
  - d. excessive FFD
  - e. excessive developing time
5. If a film packet is placed in the patient's mouth with the wrong side facing the x-ray beam, the resulting film will
  - a. be blank
  - b. have a thin image
  - c. be overexposed
  - d. show no effect
  - e. have a thin image with a geometric pattern on it
6. The failure to remove partial dentures while taking radiographs may cause
  - a. collimator cutoff
  - b. a blurred image
  - c. superimposition of the metallic object on the film
  - d. overlapped images
  - e. double exposure
7. A "long cone" (16-inch FFD) is used in the paralleling technique to
  - a. reduce secondary radiation
  - b. avoid magnification of the image
  - c. avoid distortion of the image
  - d. avoid superimposition of the zygomatic arch
  - e. facilitate correct vertical angulation
8. Using a localizing ring with a film holder helps in preventing
  - a. collimator cutoff
  - b. elongation
  - c. foreshortening
  - d. overlapping
  - e. overexposure
9. The projection most likely to excite the gag reflex is the
  - a. mandibular molar projection
  - b. maxillary molar projection
  - c. molar bitewing projection
  - d. premolar bitewing projection
  - e. maxillary canine projection
10. The best way to prevent patient movement during intraoral radiography is
  - a. fast film
  - b. short PIDs
  - c. good operator technique
  - d. high kilovoltage peak
  - e. high milliamperage
11. In using a film-holding device with a localizing ring, it is not necessary that
  - a. the occlusal plane be parallel to the floor
  - b. the sagittal plane be perpendicular to the floor
  - c. the backrest be elevated
  - d. the headrest be under the occiput
  - e. all of the above
12. A full-mouth survey
  - a. always has periapical and bitewing films
  - b. has a minimum of 20 films
  - c. varies in need and number of films according to selection criteria and mouth size
  - d. can be replaced in all cases by a panoramic film
  - e. none of the above
13. Another correct way to refer to the paralleling method is
  - a. short cone technique
  - b. right-angle technique
  - c. periapical method
  - d. bitewing method
  - e. none of the above

14. In order to avoid creating an artifact on the apex of the tooth when placing the film in the film holder, which of the following statements is accurate?
- "The dot" should be away from "the slot."
  - "The dot" should be on the opposite side of "the slot."
  - It doesn't matter where "the dot" is placed.
  - "The dot" should be in "the slot."
  - Placement of "the dot" depends on the projection being taken.
15. Placement of the premolar projection should include
- the first and second premolars
  - most of the first molar
  - the distal of the canine
  - only the first and second premolars
  - a, b, and c

## VII. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

- A bitewing film shows the entire tooth from the occlusal surface or incisal edge to the apex of the tooth. **T/F**
- The basic principle of the paralleling technique is that the tooth and film should be parallel to each other. **T/F**
- The use of film holders is strongly discouraged in intraoral radiography. **T/F**
- The most common exposure error in the paralleling technique is in film placement. **T/F**
- Blurred images are the result of reversing the film in the patient's mouth. **T/F**

# Accessory Radiographic Techniques: Bisecting Technique and Occlusal Projections

## Educational Objectives

*After reading Chapter 11 of the textbook and completing this exercise, the student will*

1. Understand the geometry of film placement and beam alignment of the bisecting technique.
2. Be able to apply this understanding in the clinical setting and take a full-mouth survey on dentulous and edentulous patients using the bisecting technique.
3. Understand the indications for occlusal radiographs and be able to take these films.

## I. Definitions

Define/explain the following terms.

1. Bisecting the angle technique \_\_\_\_\_  
\_\_\_\_\_
2. Buccolingual dimension \_\_\_\_\_  
\_\_\_\_\_
3. Dimensional distortion \_\_\_\_\_  
\_\_\_\_\_
4. Elongated image \_\_\_\_\_  
\_\_\_\_\_
5. Film plane \_\_\_\_\_  
\_\_\_\_\_
6. Foreshortened image \_\_\_\_\_  
\_\_\_\_\_
7. Imaginary bisecting line \_\_\_\_\_  
\_\_\_\_\_

8. Headrest position \_\_\_\_\_  
\_\_\_\_\_
9. Horizontal angulation \_\_\_\_\_  
\_\_\_\_\_
10. Negative angulation \_\_\_\_\_  
\_\_\_\_\_
11. Occlusal film packet \_\_\_\_\_  
\_\_\_\_\_
12. Occlusal plane orientation \_\_\_\_\_  
\_\_\_\_\_
13. Occlusal projection \_\_\_\_\_  
\_\_\_\_\_
14. Overlapped image \_\_\_\_\_  
\_\_\_\_\_
15. Positive angulation \_\_\_\_\_  
\_\_\_\_\_
16. Right-angle occlusal projection \_\_\_\_\_  
\_\_\_\_\_
17. Sagittal plane orientation \_\_\_\_\_  
\_\_\_\_\_
18. Short cone \_\_\_\_\_  
\_\_\_\_\_
19. Topographic occlusal projection \_\_\_\_\_  
\_\_\_\_\_
20. Vertical angulation \_\_\_\_\_  
\_\_\_\_\_

## II. Comprehension Exercise

1. Describe the advantages of the bisecting technique as compared to the paralleling technique.

2. What generally is the indication for use of an occlusal projection? What are the specific indications for topographic versus right-angle projections?
3. Describe the disadvantages of the bisecting technique when compared to the paralleling technique.
4. Describe the method used with the bisecting-angle technique.
5. Explain the difference between horizontal angulation and vertical angulation. What does each determine?
6. In the bisecting technique, what dictates the point of entry?
7. Why is the thyroid dose higher in the bisecting technique than in the paralleling technique?

8. In intraoral radiography, what is the correct sagittal plane orientation for the patient's head?
9. Why does the bisecting technique call for an 8-inch focal-film distance (FFD)?
10. In the bisecting technique, what determines the variations in vertical angulation from one projection to another?
11. Explain why it is necessary to use occlusal projections when localizing impacted teeth.
12. In an edentulous survey, what is the main reason for using topographic occlusal films? Name two alternatives.
13. Why is the use of shorter exposure times with the bisecting technique not valid as an advantage at this point in time?



14. In the bisecting technique, why is occlusal plane orientation so critical?

15. Explain why the topographic occlusal projection is said to be a modification of the bisecting technique.

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### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

*Column A*

- \_\_\_\_\_ 1. elongation
- \_\_\_\_\_ 2. buccolingual localization
- \_\_\_\_\_ 3. 8-inch FFD
- \_\_\_\_\_ 4. poor sagittal plane orientation
- \_\_\_\_\_ 5. foreshortening
- \_\_\_\_\_ 6. higher thyroid dose
- \_\_\_\_\_ 7. occlusal plane
- \_\_\_\_\_ 8. overlapped image
- \_\_\_\_\_ 9. greater exit dose
- \_\_\_\_\_ 10. short buccal image structure
- \_\_\_\_\_ 11. dimensional accuracy
- \_\_\_\_\_ 12. large pathologic areas
- \_\_\_\_\_ 13. positive angulation
- \_\_\_\_\_ 14. negative angulation
- \_\_\_\_\_ 15. #4 size film

*Column B*

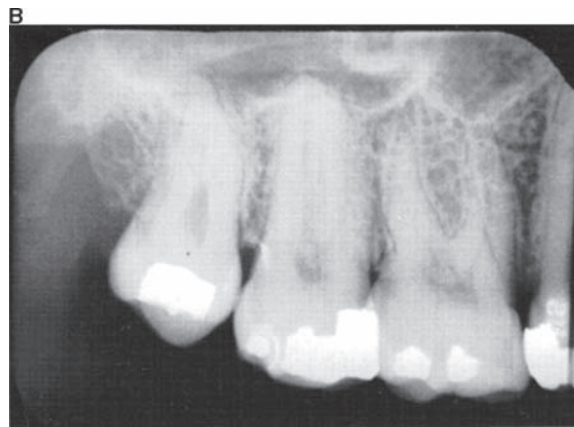
- a. bisecting technique
- b. parallel to the floor
- c. dimensional distortion
- d. topographic occlusal
- e. poor horizontal angulation
- f. image magnification
- g. insufficient vertical angulation
- h. occlusal film size
- i. too much vertical angulation
- j. periapical film size
- k. right-angle occlusal projection
- l. mandibular arch
- m. fogged image
- n. elongation
- o. maxillary arch
- p. 8-inch FFD
- q. paralleling technique

## IV. Illustrations

1. Draw the correct relationship of the central ray, teeth, and film in a diagram of horizontal angulation using the bisecting technique as compared with the paralleling technique.

2. Diagram the relationship of the central ray, tooth, and film packet for the bisecting technique.

3. (Figure 11-1) Which of these maxillary molar periapical films, A or B, was taken with the paralleling technique? Which was taken with the bisecting technique?



a. \_\_\_\_\_

b. \_\_\_\_\_

4. (Figure 11-2) What error was made here?  
What caused it?



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5. (Figure 11-3) Was too little or too much vertical angulation used to produce this radiograph? What error is the result?

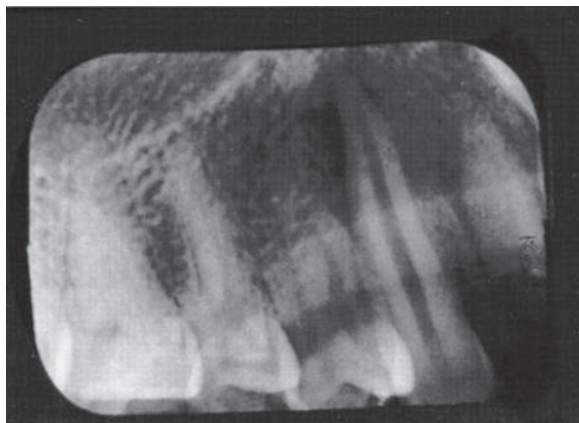


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6. (Figure 11-4) Identify the error seen here, and explain how you would correct it.

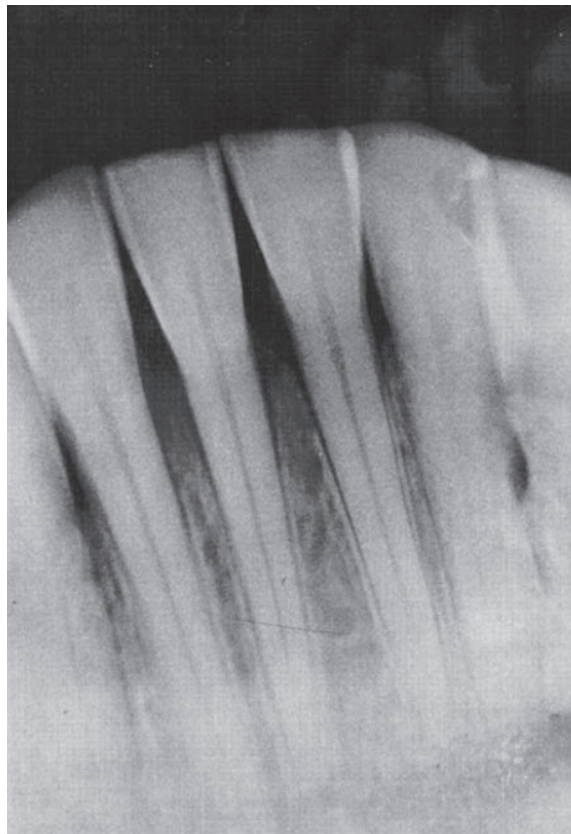


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7. (Figure 11-5) In this film taken with the bisecting technique, how would you describe the image? What technique error caused it?



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## V. Complete These Statements

1. The projection of choice to completely visualize a palatal lesion would be \_\_\_\_\_.
2. The dose to the thyroid gland is \_\_\_\_\_ in the bisecting technique when compared to the paralleling technique because of \_\_\_\_\_.
3. The correct chair position for the bisecting technique requires that the sagittal plane of the patient's face is \_\_\_\_\_ to the floor.
4. The anatomic landmark for the point of entry for the mandibular bicuspid periapical film is the \_\_\_\_\_.
5. Periodontal bone height may be exaggerated in the bisecting technique because of \_\_\_\_\_.
6. In the bisecting technique an overly dense film may be caused by \_\_\_\_\_ or \_\_\_\_\_.
7. Foreshortening can be caused by excessive vertical angulation or poor \_\_\_\_\_ orientation.
8. Two projections other than periapical films that can be used in an edentulous survey of the mandible are \_\_\_\_\_ and \_\_\_\_\_.
9. Usually the FFD used in the paralleling technique is \_\_\_\_\_ than in the bisecting technique.
10. The major disadvantage of the bisecting technique is that the image projected on the film is \_\_\_\_\_.
11. The vertical angulation for the maxillary incisors in the bisecting technique would be about \_\_\_\_\_ degrees.
12. In the bisecting technique the film packet should be held in the patient's mouth with a \_\_\_\_\_.
13. Horizontal angulation is established so that the \_\_\_\_\_ is perpendicular to the film in the \_\_\_\_\_ plane.
14. Occlusal film has the \_\_\_\_\_ speed (sensitivity) as periapical film size #2.
15. The angulation of the \_\_\_\_\_ may vary from 45 to 75 degrees, depending on the anatomic area.

## VI. Multiple Choice

Select the best answer.

1. You have decided to change the PID in your office, replacing the 16-inch cylinder with an 8-inch cylinder. The milliamperage will remain the same, as will the kilovolt peak value. The old exposure time for mandibular molars was 36 impulses; the new exposure time to obtain films of equal density will be
  - a. 12 impulses
  - b. 24 impulses
  - c. 18 impulses
  - d. 9 impulses
  - e. 48 impulses

2. The posterior topographic view of the maxilla can be considered a topographic view of the
  - a. zygoma
  - b. maxillary sinus
  - c. zygomatic process
  - d. maxillary tuberosity
  - e. none of the above
3. In taking a periapical radiograph using the bisecting technique, the x-ray beam was not centered on the film packet. The resulting film shows
  - a. fogging
  - b. overlapping
  - c. collimator cutoff
  - d. foreshortening
  - e. elongation
4. In taking a periapical radiograph of the maxillary incisor area by the bisecting technique, using a vertical angulation of +15 degrees will result in a film that
  - a. has collimator cutoff
  - b. is foreshortened
  - c. is elongated
  - d. is overlapped
  - e. is correct
5. When using the bisecting-angle technique for a maxillary premolar projection, the point of entry is
  - a. the base of the lateral nasal groove
  - b. just below the midpoint of the nares
  - c. the most anterior part of the cheekbone
  - d. the zygomatic arch
  - e. none of the above
6. The best way to visualize a salivary stone in the floor of the mouth is by using
  - a. panoramic projection
  - b. maxillary occlusal projection
  - c. mandibular central incisor projection
  - d. mandibular right-angle occlusal projection
  - e. mandibular topographic occlusal projection
7. Occlusal film is classified as size
  - a. #2
  - b. #0
  - c. #4
  - d. #3
  - e. #1
8. For the maxillary molar periapical projection, the center of the film packet should be aligned with
  - a. the junction between the first and second molars
  - b. the middle of the first molar
  - c. the junction between the second and third molars
  - d. the middle of the second molar
  - e. none of the above
9. In the bisecting technique, if the central ray is not perpendicular to the film packet in the horizontal plane, the resulting film will be
  - a. foreshortened
  - b. overlapped
  - c. "cone cut"
  - d. elongated
  - e. blurred
10. Using the bisecting technique in taking a periapical radiograph of tooth #32, using a vertical angulation of -30 degrees will result in a film that is
  - a. foreshortened
  - b. overlapped
  - c. elongated
  - d. "cone cut"
  - e. reversed
11. What would be the projection of choice to visualize a large lesion in the midline of the palate?
  - a. panoramic
  - b. maxillary right-angle occlusal
  - c. maxillary topographic occlusal
  - d. maxillary molar periapical
  - e. maxillary incisor periapical

12. When using the bisecting technique, the point of entry for the mandibular molar projection is the
  - a. roots of the molars
  - b. root of the first molar
  - c. cemento-enamel junction of the molars
  - d. crowns of the molars
  - e. bifurcation of the second molar
13. The film speed of occlusal film is
  - a. slower than periapical film
  - b. the same as periapical film
  - c. faster than bitewing film
  - d. the same as panoramic film
  - e. faster than periapical film
14. The best projection to decide whether an impacted maxillary cuspid is located buccally or lingually is the
  - a. maxillary topographic occlusal
  - b. panoramic
  - c. cuspid periapical using the paralleling method
  - d. cuspid periapical using the bisecting method
  - e. maxillary right-angle occlusal
15. The bisecting-angle technique may be an advantageous technique to use with
  - a. small children
  - b. people with low palatal vaults
  - c. patients with small mouths
  - d. patients with anatomic constraints prohibiting the use of paralleling devices
  - e. all of the above

## VII. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

1. In the bisecting technique, the film is placed parallel to the occlusal surfaces of the teeth being radiographed. **T/F**
2. The major disadvantage of the bisecting technique is dimensional inaccuracy. **T/F**
3. In the bisecting technique, the central ray is directed perpendicular to an imaginary bisecting line between the tooth and film. **T/F**
4. Foreshortening is a result of overbending of the film packet in the bisecting technique. **T/F**
5. Occlusal radiographs are seldom taken to view salivary stones in the submandibular gland. **T/F**

# Panoramic Radiography

## Educational Objectives

*After reading Chapter 12 of the textbook and completing this exercise, the student will*

1. Understand the principles of tomography and how they apply to dental panoramic x-ray units.
2. Be able to learn to use any of the panoramic units available today.

## I. Definitions

Define/explain the following terms.

1. Ala-tragus line \_\_\_\_\_  
\_\_\_\_\_
2. Digital imaging \_\_\_\_\_  
\_\_\_\_\_
3. Electrostatic artifact \_\_\_\_\_  
\_\_\_\_\_
4. Focal trough \_\_\_\_\_  
\_\_\_\_\_
5. Frankfort horizontal plane \_\_\_\_\_  
\_\_\_\_\_
6. Ghost image \_\_\_\_\_  
\_\_\_\_\_
7. Image layer \_\_\_\_\_  
\_\_\_\_\_
8. Midsagittal plane \_\_\_\_\_  
\_\_\_\_\_
9. Panoramic radiography \_\_\_\_\_  
\_\_\_\_\_
10. "Panorex" \_\_\_\_\_  
\_\_\_\_\_



11. Pantomograph \_\_\_\_\_  
\_\_\_\_\_
12. Point of rotation \_\_\_\_\_  
\_\_\_\_\_
13. Slit beam \_\_\_\_\_  
\_\_\_\_\_
14. Tomographic cut \_\_\_\_\_  
\_\_\_\_\_
15. Tomography \_\_\_\_\_  
\_\_\_\_\_

## II. Comprehension Exercise

1. What are the advantages of a panoramic radiograph when compared to a full-mouth intraoral survey?
2. What are the disadvantages of a panoramic radiograph when compared to a full-mouth intraoral survey?
3. What does the term panorama mean? What is the term's significance in panoramic radiography?

4. Why is patient jaw position so important in panoramic radiography?
5. How is patient movement avoided in panoramic radiography?
6. What are the two techniques available that produce panoramic films? Which technique is more widely used? Why?
7. What special precautions are necessary when processing panoramic films?
8. In panoramic radiography, what is a ghost image? How can it be avoided?
9. How can panoramic units be used to take tomograms of the temporomandibular joint (TMJ)?

10. What is the focal trough?

11. What is a “computer-driven tomographic unit”?

12. What is the main indication for panoramic radiographs?

13. What is a tomographic “slice” or “cut?”

14. Why are panoramic radiographs not recommended for caries detection and periodontal bone evaluation?

15. Is digital imaging available for panoramic units? If so, explain the basic principles involved.

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

#### Column A

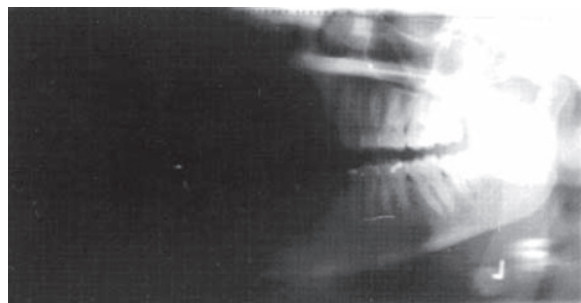
- \_\_\_\_\_ 1. rare earth elements
- \_\_\_\_\_ 2. tomogram
- \_\_\_\_\_ 3. focal trough
- \_\_\_\_\_ 4. static marks
- \_\_\_\_\_ 5. circular tube motion
- \_\_\_\_\_ 6. thyroid collar
- \_\_\_\_\_ 7. tongue position
- \_\_\_\_\_ 8. patient movement
- \_\_\_\_\_ 9. mandibular condyle
- \_\_\_\_\_ 10. intraoral x-ray source
- \_\_\_\_\_ 11. open and closed view
- \_\_\_\_\_ 12. slouching patient
- \_\_\_\_\_ 13. tomographic series
- \_\_\_\_\_ 14. first panoramic unit
- \_\_\_\_\_ 15. ghost image

#### Column B

- a. plane of acceptable detail
- b. TMJ tomography
- c. Panorex
- d. tightly packed film
- e. objects with high density
- f. radiopaque triangle
- g. seen on pantomograms
- h. not used for pantomograms
- i. thyroid collar
- j. multiple cuts
- k. pharyngeal air space
- l. rotating anode
- m. blurred image
- n. intensifying screen
- o. laminogram
- p. tomogram
- q. distorted image

### IV. Illustrations

1. (Figure 12-1) What error is shown here?




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2. (Figure 12-2) What error was made here?




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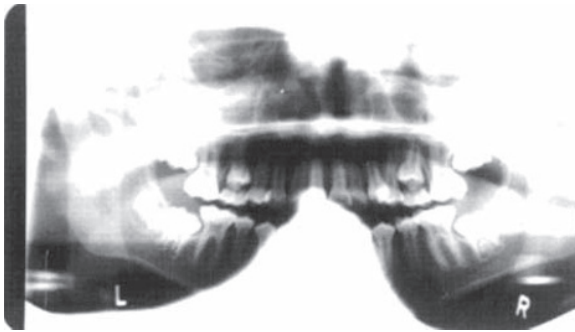


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3. (Figure 12-3) What error was made here?




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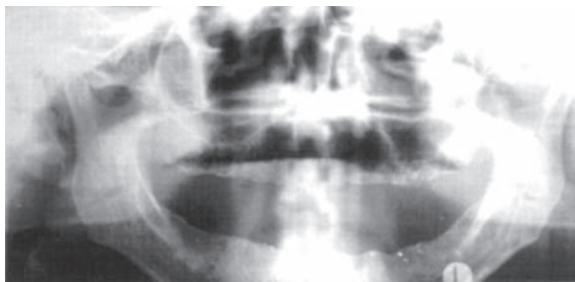


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4. (Figure 12-4) What error was made here?




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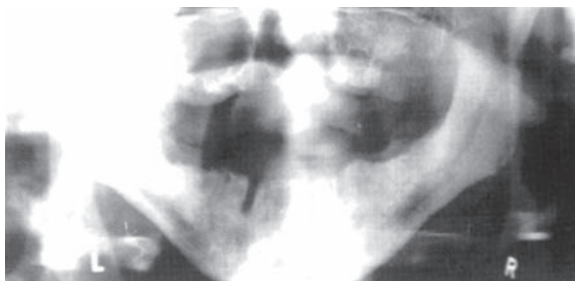


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5. (Figure 12-5) What error was made here?




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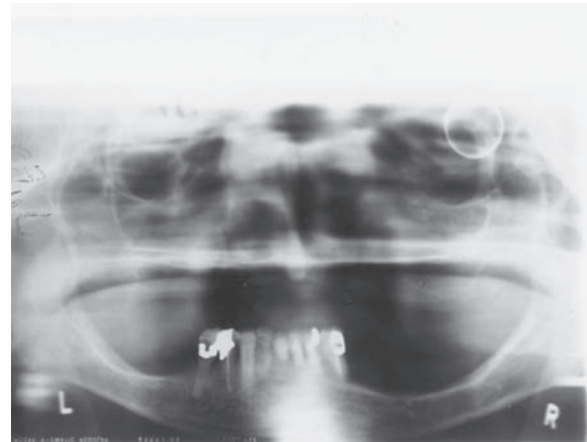


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6. (Figure 12-6) What is the circular radiopaque structure in the right posterior maxilla?




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## V. Complete These Statements

- Three anatomic landmarks seen on panoramic films that do not appear on intraoral full-mouth series are the \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
- The area of the maxilla that is seen with least amount of definition on a panoramic radiograph is the \_\_\_\_\_.
- The panoramic image does not have the same \_\_\_\_\_ that is seen on intraoral periapical or bitewing film.
- The main advantage of a panoramic radiograph over intraoral periapical films is the \_\_\_\_\_.

5. The bilateral radiolucent structures seen crossing the ramus of the mandible on panoramic radiographs are the \_\_\_\_\_.
6. Multiple black linear streaks on a panoramic radiograph are a result of \_\_\_\_\_.
7. Another name for the “plane of acceptable detail” is the \_\_\_\_\_.
8. In comparing patient radiation dose, panoramic radiographs require \_\_\_\_\_ radiation than a full-mouth series.
9. In panoramic radiography, the midsagittal plane should be \_\_\_\_\_ to the floor and the \_\_\_\_\_ plane and the \_\_\_\_\_ line should be \_\_\_\_\_ to the floor for correct patient positioning.
10. When taking a panoramic radiograph the patient's tongue should always be \_\_\_\_\_.
11. The main disadvantage of panoramic films when compared to a full-mouth survey is \_\_\_\_\_.
12. A lead apron should be used without a \_\_\_\_\_ for panoramic radiography.
13. A recently reported use of panoramic films is the detection of \_\_\_\_\_ in the patient's neck region.
14. An image from the other side of the patient's jaw that is seen as a blurred shadow is called a \_\_\_\_\_ image.
15. The most skilled operator requires at least 15 to 20 minutes to perform an intraoral survey; pantomographs can be taken in less than \_\_\_\_\_.

## VI. Multiple Choice

Select the best answer.

1. When taking a pantomogram, the patient's lead apron should
  - a. be placed in the usual manner
  - b. not be used at all
  - c. be placed on the back of the patient
  - d. not be placed lower than the clavicles
  - e. be placed over the thyroid area
2. Object scatter degrading the image is not a concern in panoramic radiography
  - a. because of the rotation of the tube head
  - b. because of the narrow slit beam
  - c. because of the inherent filtration
  - d. because the patient is seated
  - e. because of the intensifying screens
3. In positioning a patient for panoramic radiography, if the patient's head is tilted up
  - a. a right oblique (RO) triangle is seen in the mandibular anterior region
  - b. a radiolucent (RL) line is seen above the apices of the maxillary teeth
  - c. the chin is back and the forehead is forward
  - d. the RO palate is superimposed over the apices of the upper teeth
  - e. the lower anterior teeth appear narrow and blurred
4. Each successive panoramic film appears lighter than the one before. Which of the following corrections should be made?
  - a. increase the mA setting
  - b. increase the kVp setting
  - c. change the intensifying screen
  - d. change the developer solution
  - e. reduce the temperature of the developer

5. Which of the following anatomic structures is usually not seen on intraoral periapical radiographs but is seen on pantomograms?
  - a. mental foramen
  - b. mandibular foramen
  - c. mylohyoid ridge
  - d. coronoid process
  - e. median palatal suture
6. If the lead apron is placed too high on the patient,
  - a. it will create a large RL on the film
  - b. it will create a large RO on the film
  - c. it will create an RO on the maxilla
  - d. it will obliterate all the mandibular teeth
  - e. it will create a vertical RL line on the film
7. The main reason for taking a panoramic radiograph would be
  - a. to lower the patient's exposure
  - b. to see the borders of a lesion that are larger than periapical film
  - c. that it requires less time
  - d. for better object definition
  - e. the film cost
8. Grids are usually not used with panoramic units because
  - a. there is no object scatter
  - b. the moving field size is very narrow
  - c. the motion makes grids ineffective
  - d. the film is too sensitive
  - e. the mA setting is not high enough
9. Panoramic radiographs cannot be used for detection of
  - a. impacted teeth
  - b. jaw fractures
  - c. caries and periodontal disease
  - d. large areas of pathology
  - e. eruption patterns
10. In taking a tomographic series, the depth of "cuts" can be varied by
  - a. varying the focal object distance
  - b. changing the kVp setting
  - c. varying the mA setting
  - d. changing the type of motion
  - e. increasing the exposure time
11. The main advantage of using an intraoral source for panoramic radiography is
  - a. better tooth definition
  - b. less image distortion
  - c. no film is necessary
  - d. significant reduction in patient radiation dose
  - e. less image magnification
12. Common positioning requirements for panoramic units include
  - a. the anterior teeth are positioned in the proper groove in the bite block
  - b. the ala-tragus line should be parallel to the floor
  - c. the midsagittal plane should be perpendicular to the floor
  - d. the chin should not be angled up or down
  - e. all of the above
13. In positioning the patient for a pantomographic radiograph, if the patient is too far forward
  - a. the hard palate will be superimposed on the maxillary anteriors
  - b. the upper and lower anterior teeth will be blurred
  - c. the film cassette will hit the patient's head
  - d. the posterior teeth will be blurred
  - e. there will be a radiolucent streak on the film

14. The use of rare earth intensifying screens in pantomographic units
  - a. is not possible
  - b. is not necessary
  - c. is recommended
  - d. would not decrease the radiation dose to the brain
  - e. would not decrease the radiation dose to the thyroid
15. Advantages of panoramic radiography include all of the following *except*
  - a. less time
  - b. better patient cooperation
  - c. overuse
  - d. lower bone marrow dose
  - e. simple to perform

## VII. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

1. A panoramic radiograph is produced by moving the film and x-ray source in the same direction around the patient. **T/F**
2. Most of the errors in panoramic radiography are as a result of poor patient positioning. **T/F**
3. If the patient is positioned too far forward, the lower anterior teeth will appear blurred and widened. **T/F**
4. The main indication for panoramic radiography is attaining a larger field size than is possible with periapical radiography. **T/F**
5. Ghosting will occur if static electricity is caused during processing of panoramic film. **T/F**



## Educational Objectives

*After reading Chapter 13 of the textbook and completing this exercise, the student will*

1. Understand the indications for extraoral projections and be able to apply them in clinical practice.
2. Understand the use of intensifying screens and grids and their clinical importance.
3. Be able to take the extraoral projections discussed in the chapter.

## I. Definitions

Define/explain the following terms.

1. Cassette \_\_\_\_\_  
\_\_\_\_\_
2. Cephalometric radiography \_\_\_\_\_  
\_\_\_\_\_
3. Extraoral projection \_\_\_\_\_  
\_\_\_\_\_
4. Film-holding board \_\_\_\_\_  
\_\_\_\_\_
5. Grid \_\_\_\_\_  
\_\_\_\_\_
6. Lateral oblique projection \_\_\_\_\_  
\_\_\_\_\_
7. Lateral skull projection \_\_\_\_\_  
\_\_\_\_\_
8. Object scatter \_\_\_\_\_  
\_\_\_\_\_

9. Submentovertex (SMV) projection \_\_\_\_\_

\_\_\_\_\_

10. Waters projection \_\_\_\_\_

\_\_\_\_\_

## II. Comprehension Exercise

1. Describe three clinical indications for using extraoral films in dentistry.
2. Which extraoral projection is most diagnostic for pathologic conditions of the maxillary sinus? How is this film taken?
3. What type of x-ray unit is used for taking extraoral radiographs?
4. What special precautions must be taken in the darkroom when loading cassettes and processing extraoral films?
5. What are the advantages of using rare earth intensifying screens?

6. What equipment is needed for taking standard extraoral projections?
7. How can you identify the right and left sides in addition to labeling patient information on extraoral film?
8. Explain how and why the film-screen system is used in extraoral radiography.
9. How can one differentiate the left side of the patient from the right on an extraoral radiograph?
10. How does the use of intensifying screens reduce the exposure needed for radiographs?
11. What six factors should be known for every extraoral projection?

12. If a periapical film of an impacted mandibular third molar cannot be positioned so that the complete root can be seen, what would you do?
13. What is object scatter?
14. What is the lateral oblique projection of the mandible used to survey? Why is this projection ideal for visualizing?
15. Why are grids not necessary in periapical, bitewing, and panoramic radiographs?
16. Why do you need a minimum of 36 inches focal-film distance (FFD) for a lateral skull projection?
17. What are the advantages of an extraoral film holder over the patient holding the cassette?

18. Why are grids used in extraoral projections and not for intraoral film?

19. What does varying mA and kVp settings depend on in extraoral radiography?

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

#### *Column A*

- \_\_\_\_\_ 1. grid
- \_\_\_\_\_ 2. lateral skull projection
- \_\_\_\_\_ 3. rigid cassette
- \_\_\_\_\_ 4. thyroid collar
- \_\_\_\_\_ 5. midline fracture of mandible
- \_\_\_\_\_ 6. left and right side
- \_\_\_\_\_ 7. minimum safelight
- \_\_\_\_\_ 8. posteroanterior projection
- \_\_\_\_\_ 9. lateral oblique projection
- \_\_\_\_\_ 10. Waters projection
- \_\_\_\_\_ 11. reduce patient exposure
- \_\_\_\_\_ 12. cephalostat
- \_\_\_\_\_ 13. submentovertex
- \_\_\_\_\_ 14. point of entry
- \_\_\_\_\_ 15. fogged film

#### *Column B*

- a. fractures of the cheekbone
- b. improper safelight
- c. processing extraoral film
- d. articular disc
- e. external auditory meatus
- f. extraoral projection
- g. head positioning
- h. cephalometric
- i. posteroanterior projection
- j. need lead marker
- k. maxillary sinusitis
- l. position with forehead and nose against cassette
- m. intensifying screens
- n. object scatter
- o. fractured mandible
- p. film packet
- q. not used in extraoral radiography

## IV. Illustrations

1. (Figure 13-1) Identify this radiographic projection.



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2. Draw a schematic of the radiographic technique used for the projection in Figure 13-1.

3. (Figure 13-2) Identify this radiographic projection.



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4. Draw a schematic of the radiographic technique used for the projection in Figure 13-2.

5. (Figure 13-3) Identify this radiographic projection.



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6. Draw a schematic of the radiographic technique used for the projection in Figure 13-3.

7. Make a drawing that illustrates the use of a grid in dental radiography.

8. (Figure 13-4) Identify this radiographic projection.

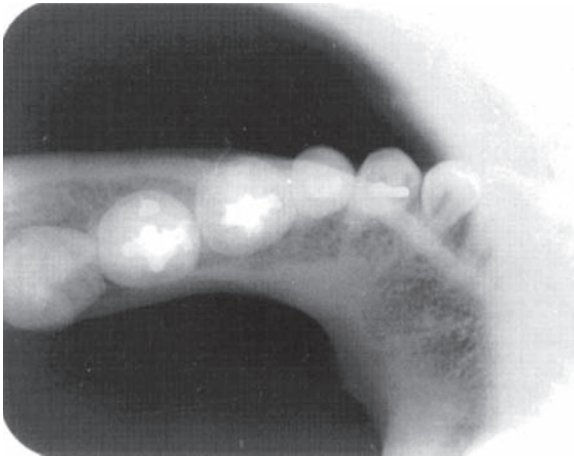


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9. (Figure 13-5) What radiographic projection is seen here? Be specific!



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10. (Figure 13-6) What radiographic projection is seen here? Be specific!



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## V. Complete These Statements

1. When comparing radiographic detail, it can be said that film-screen combinations produce \_\_\_\_\_ detail when compared with film alone.
2. Some states have statutes that \_\_\_\_\_ or \_\_\_\_\_ certain members of the dental health team from performing specific extraoral radiographic techniques.
3. Patients who have \_\_\_\_\_ or \_\_\_\_\_ cannot open their mouths and would benefit from an extraoral radiographic series.
4. The extraoral projection that is most diagnostic for the maxillary sinus is the \_\_\_\_\_.
5. The two extraoral projections that are needed to visualize a fracture of the angle of the mandible are \_\_\_\_\_ and \_\_\_\_\_.
6. Orthodontists would most likely use the \_\_\_\_\_ for cephalometric measurements.
7. In extraoral radiography the field size is \_\_\_\_\_ than in intraoral radiography.
8. The lateral skull projection would not be used to visualize a large mandibular cyst because of \_\_\_\_\_.



9. The \_\_\_\_\_ provides a means of localizing changes in a mediolateral direction.
10. Grids are not used in panoramic radiography because \_\_\_\_\_.
11. Extraoral films are processed \_\_\_\_\_ as intraoral films.
12. The increased FFD utilized in extraoral radiography is necessary to get a sufficiently large \_\_\_\_\_ at the patient's face.
13. In both the lateral skull and posterior anterior projections, the sagittal plane of the patient's skull is \_\_\_\_\_ to the floor.
14. For the lateral skull projection, the central ray is directed at the \_\_\_\_\_.
15. The \_\_\_\_\_ projection is used to visualize the sphenoid and ethmoid sinuses.
2. Grids are used to
  - a. mark films
  - b. reduce background radiation
  - c. reduce field size
  - d. collimate the x-ray beam
  - e. reduce object scatter
3. In extraoral radiography, an increased FFD is necessary to
  - a. decrease patient exposure
  - b. increase the beam divergence
  - c. decrease the beam divergence
  - d. increase film quality
  - e. decrease image magnification
4. The best way to visualize maxillary sinus pathology using a dental x-ray machine is a
  - a. lateral oblique projection
  - b. maxillary occlusal projection
  - c. posterior anterior projection
  - d. transcranial projection
  - e. Waters projection
5. In taking a Waters projection the patient's
  - a. head is inclined 15 degrees
  - b. nose and chin touch the cassette, mouth open
  - c. nose and chin touch the cassette, mouth closed
  - d. forehead and nose touch the cassette, mouth open
  - e. forehead and chin touch the cassette
6. Extraoral cassettes
  - a. may be rigid or flexible
  - b. contain intensifying screens
  - c. are light-tight
  - d. are available in varying sizes
  - e. all of the above

## VI. Multiple Choice

Select the best answer.

1. The best extraoral projection for viewing an impacted left mandibular third molar is
  - a. submental vertex
  - b. posterior anterior
  - c. left lateral oblique
  - d. lateral skull
  - e. right lateral oblique
7. If all of your extraoral films appear dense and fogged after processing while your intraoral films are satisfactory, the probable cause is
  - a. the solutions are too hot
  - b. white light exposure in the darkroom
  - c. the safelight is too intense
  - d. the safelight is too weak
  - e. the solutions are exhausted

8. Extraoral films are processed
  - a. only with automatic processors
  - b. by the time-temperature method
  - c. by sight development
  - d. with special solutions
  - e. none of the above
9. Holding devices have the advantage
  - a. of preventing a fogged film
  - b. of standardizing techniques
  - c. preventing patient and film movement
  - d. Both a and c are acceptable answers.
  - e. Both b and c are acceptable answers.
10. A fractured zygomatic arch can be seen on a(an)
  - a. lateral oblique projection
  - b. posteroanterior projection
  - c. Waters projection
  - d. anteroposterior projection
  - e. lateral skull projection
11. The major disadvantage of using extraoral projections with screens in dentistry is
  - a. the cost of the equipment
  - b. problems with processing
  - c. an increased radiation dose
  - d. decreased definition
  - e. operative difficulty
12. The screen film used in extraoral radiography is
  - a. more sensitive to light
  - b. more sensitive to radiation
  - c. equally sensitive to both light and radiation
  - d. not changed by light or radiation
  - e. none of the above are significant statements
13. A pathologic condition in the midline of the mandible can best be diagnosed using
  - a. a right lateral oblique projection
  - b. a lateral skull projection
  - c. a left lateral oblique projection
  - d. a Waters projection
  - e. a posteroanterior projection
14. The lateral oblique projection of the mandible is not diagnostic anterior to the canine because of the superimposition caused by
  - a. the mental ridges
  - b. the mental eminence
  - c. the genial tubercles
  - d. the anterior curve of the mandible
  - e. the lingual foramen
15. Exposure, mA, and kVp settings vary with extraoral radiographs depending on the
  - a. film speed
  - b. intensifying screen
  - c. size of the patient
  - d. None of the above are possible answers.
  - e. All of the above are possible answers.

## VII. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

1. Some states have statutes that prohibit or limit the dental professional from performing certain extraoral techniques. **T/F**
2. Extraoral screen films are less sensitive to light than are intraoral films. **T/F**
3. The lateral oblique projection of the mandible is used for viewing mandibular third molar impactions and pathology. **T/F**
4. Waters view of the maxillary sinuses is used for maxillary sinus pathologic conditions and facial fractures of the upper third of the face. **T/F**
5. For the submentovertex projection, the central ray is directed from beneath the chin at 45° to the cassette. **T/F**

# Radiography of the Temporomandibular Joint

## Educational Objectives

*After reading Chapter 14 of the textbook and completing this exercise, the student will*

1. Know and understand the imaging techniques available for viewing the temporomandibular joint (TMJ).

## I. Definitions

Define/explain the following terms.

1. Arthritic changes \_\_\_\_\_  
\_\_\_\_\_
2. Articular disc \_\_\_\_\_  
\_\_\_\_\_
3. Arthrography \_\_\_\_\_  
\_\_\_\_\_
4. Basal projection \_\_\_\_\_  
\_\_\_\_\_
5. Computed tomography (CT) \_\_\_\_\_  
\_\_\_\_\_
6. Contrast medium \_\_\_\_\_  
\_\_\_\_\_
7. External auditory meatus \_\_\_\_\_  
\_\_\_\_\_
8. Magnetic resonance imaging (MRI) \_\_\_\_\_  
\_\_\_\_\_
9. Positioning board \_\_\_\_\_  
\_\_\_\_\_
10. Transcranial technique \_\_\_\_\_  
\_\_\_\_\_

## II. Comprehension Exercise

1. Discuss the use of conventional tomography in TMJ radiography.
2. How is a contrast medium used in articular disc imaging?
3. Which anatomic structures of the TMJ cannot be seen with routine radiographic imaging?
4. List the pathologic conditions of the TMJ that may be visible on radiographs.
5. Why should dental professionals feel comfortable in dealing with radiographic images of the TMJ?
6. Explain the advantage of using CT in TMJ radiography.

7. Briefly describe the transcranial imaging technique used in viewing the TMJ.
8. What is the advantage of using positioning boards in the transcranial imaging technique?
9. Which anatomic structures of the TMJ should be identifiable on radiographs?
10. Why is MRI very effective in viewing the articular disc of the TMJ? Explain.

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### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

*Column A*

- \_\_\_\_\_ 1. CT
- \_\_\_\_\_ 2. articular disc
- \_\_\_\_\_ 3. TMJ pathology
- \_\_\_\_\_ 4. MRI
- \_\_\_\_\_ 5. panoramic radiograph
- \_\_\_\_\_ 6. positioning device
- \_\_\_\_\_ 7. weak signal
- \_\_\_\_\_ 8. strong signal
- \_\_\_\_\_ 9. submentovertex (SMV) projection
- \_\_\_\_\_ 10. arthrography

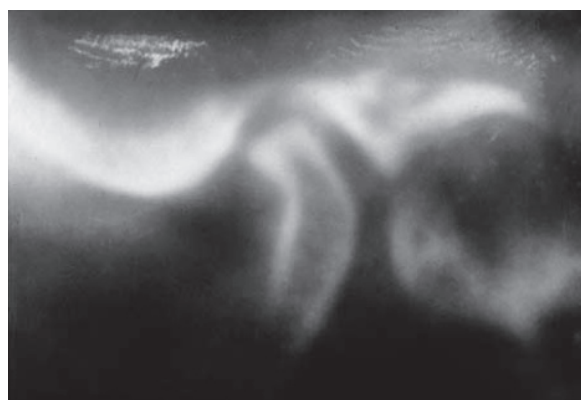
*Column B*

- a. soft tissue imaging
- b. entire maxilla and mandible
- c. axial plane
- d. meniscus
- e. lateral skull projection
- f. high density
- g. opaque contrast medium
- h. ankylosis
- i. cephalometric radiograph
- j. low density
- k. viewing in three planes
- l. transcranial technique

## IV. Illustrations

1. Draw a diagram of the normal temporomandibular joint and label all essential components.

2. (Figure 14-1) Identify all the essential components in the tomogram of the TMJ.



## V. Complete These Statements

1. Patients with symptoms relating to the \_\_\_\_\_ are not uncommon in dental practice.
2. \_\_\_\_\_ is very effective for viewing the articular disc.
3. In \_\_\_\_\_ the articular disc is outlined with an opaque contrast medium.

4. CT enables viewing of an area in \_\_\_\_\_ planes.
5. The \_\_\_\_\_ projection can also be used as a scout film for tomograms of the TMJ.
6. The internal and external \_\_\_\_\_ muscles are not seen on radiographs.
7. Since the TMJ is a movable structure, the condyle should be viewed in \_\_\_\_\_ positions.
8. The joint is anatomically bound laterally by the \_\_\_\_\_ arch.
9. Before the wide use of CT in TMJ imaging, \_\_\_\_\_ was used to examine the condyles radiographically.
10. The TMJ is anatomically bound medially by the \_\_\_\_\_ of the temporal bone.

## VI. Multiple Choice

Select the best answer.

1. Which of the following imaging techniques is considered invasive and may result in related complications?
  - a. CT
  - b. MRI
  - c. SMV projection
  - d. arthrography
  - e. none of the above
2. Pathology of the TMJ that can be visible on radiographs may include
  - a. disc displacement
  - b. fibrous adhesions
  - c. malignant tumors
  - d. a and b only
  - e. all of the above

3. The most important reason for using an angling board in transcranial radiography of the TMJ is
  - a. it is easier
  - b. less radiation is used
  - c. open and closed positions can be compared accurately
  - d. it saves film
  - e. none of the above
4. Of the following, which method is most effective in producing diagnostic images of the articular disc?
  - a. MRI
  - b. conventional tomography
  - c. CT
  - d. panoramic radiography
  - e. none of the above
5. The cassette used when producing four views of the TMJ is usually a
  - a. 5 × 7 inch cassette
  - b. 5 × 12 inch cassette
  - c. 8 × 13 inch cassette
  - d. 8 × 10 inch cassette
  - e. none of the above
6. A conventional panoramic radiograph will show both the right and left joints in
  - a. the sagittal plane
  - b. the frontal plane
  - c. the occlusal plane
  - d. the lateral plane
  - e. all of the above
7. On a magnetic resonance image of the TMJ, the articular disc will appear
  - a. opaque
  - b. lucent
  - c. mixed
  - d. radiopaque
  - e. none of the above
8. On a radiograph, the fibrocartilage associated with the TMJ will appear
  - a. RO
  - b. RL
  - c. opaque
  - d. mixed
  - e. none of the above
9. Which structures of the TMJ will appear radiopaque on a radiograph?
  - a. the condyles, articular disc, and meniscus
  - b. the glenoid fossa, cartilage, and articular fossa
  - c. the condyles, neck of the condyles, and articular eminence
  - d. the internal and external pterygoid muscles
  - e. none of the above
10. In which three positions should the TMJ be viewed?
  - a. open, shifted right, and shifted left
  - b. closed, shifted right, and shifted left
  - c. open, closed, rest
  - d. closed, rest, slightly open
  - e. none of the above

## VII. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

1. Patients with TMJ symptoms are very uncommon in dental practice. **T/F**
2. The articular disc is a minor source of TMJ disorders. **T/F**
3. Some panoramic units have specific programs for the TMJ that will also allow one to take views in the open and closed positions. **T/F**
4. Before the wide use of CT scanning, conventional tomography was one of the better ways to examine the condyle radiographically. **T/F**
5. Arthrography is an invasive procedure that may have complications. **T/F**

## Educational Objectives

*After reading Chapter 15 of the textbook and completing this exercise, the student will*

1. Understand the principles of digital imaging and how they can be used in the dental office.
2. Be able to produce images using digital radiography.

## I. Definitions

Define/explain the following terms.

1. Analogue signal \_\_\_\_\_  
\_\_\_\_\_
2. Charged coupling device (CCD) \_\_\_\_\_  
\_\_\_\_\_
3. Complementary metal oxide semiconductor (CMOS) \_\_\_\_\_  
\_\_\_\_\_
4. Detector \_\_\_\_\_  
\_\_\_\_\_
5. Digital image \_\_\_\_\_  
\_\_\_\_\_
6. Digitize \_\_\_\_\_  
\_\_\_\_\_
7. Direct digital radiography \_\_\_\_\_  
\_\_\_\_\_
8. Electronic sensor \_\_\_\_\_  
\_\_\_\_\_
9. Gray level \_\_\_\_\_  
\_\_\_\_\_
10. Hard copy \_\_\_\_\_  
\_\_\_\_\_



11. Image manipulation \_\_\_\_\_  
\_\_\_\_\_
12. Imaging plate \_\_\_\_\_  
\_\_\_\_\_
13. Optical scanning \_\_\_\_\_  
\_\_\_\_\_
14. Pixel \_\_\_\_\_  
\_\_\_\_\_
15. Storage \_\_\_\_\_  
\_\_\_\_\_
16. Phosphor \_\_\_\_\_  
\_\_\_\_\_

## II. Comprehension Exercise

1. What are the advantages of intraoral digital imaging in comparison with film?
2. What are the disadvantages of intraoral digital imaging in comparison with film?
3. What is the basic concept behind digital radiography? When and by whom was it introduced into dentistry?

4. Explain the difference between direct and indirect digital imaging.
5. Why does digital radiography produce less patient exposure to radiation than film?
6. What are the basic elements necessary to acquire a digital image?
7. Explain the difference between indirect digital radiography and optical scanning.
8. How is image definition measured? How does definition in digital radiography compare to film definition?
9. What are the three basic types of digital imaging systems?
10. What are gray levels?

11. Why is digital radiography described as environmentally friendly?
12. Name the three most common sensors employed in digital radiography. State the basic differences among the three.
13. Can the digital image be manipulated to show a third plane (axial)? If not, why not?
14. What is remote consultation? How does it apply to digital radiography?
15. What advantage of digital radiography is most appealing to dentists? Why?

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

#### *Column A*

- \_\_\_\_\_ 1. RVG
- \_\_\_\_\_ 2. optical scanning
- \_\_\_\_\_ 3. sensor
- \_\_\_\_\_ 4. storage phosphor
- \_\_\_\_\_ 5. digitize
- \_\_\_\_\_ 6. gray levels
- \_\_\_\_\_ 7. digital image definition
- \_\_\_\_\_ 8. image storage
- \_\_\_\_\_ 9. patient exposure
- \_\_\_\_\_ 10. instant image acquisition
- \_\_\_\_\_ 11. digital radiography
- \_\_\_\_\_ 12. pixels
- \_\_\_\_\_ 13. hard copies
- \_\_\_\_\_ 14. image manipulation

#### *Column B*

- a. laser scan
- b. 256
- c. processed radiographs
- d. computer
- e. group D film
- f. "filmless radiography"
- g. first dental digital unit
- h. admissible in court
- i. containers for numbers
- j. convert to numbers
- k. printouts
- l. film processing
- m. group E film
- n. direct digital image
- o. 9 to 10 line pairs per millimeter
- p. charged coupling device (CCD)
- q. 60% reduction

### IV. Complete These Statements

1. Two types of sensors used in direct digital radiography are \_\_\_\_\_ and \_\_\_\_\_.
2. When compared with D-speed film, digital radiography results in an exposure decrease of \_\_\_\_\_%.
3. When compared with E-speed film, digital radiography results in an exposure decrease of \_\_\_\_\_%.
4. In the storage phosphor unit the sensor is scanned by a \_\_\_\_\_.
5. A digital image is composed of discrete areas called \_\_\_\_\_.
6. Once acquired, the computer can change the \_\_\_\_\_ in many ways.
7. The human eye can only discern about \_\_\_\_\_ gray levels.
8. Digital images can be stored in a \_\_\_\_\_.
9. Images taken at different times can be placed on the monitor side by side for \_\_\_\_\_.
10. Digital images can be sent to an insurance company by \_\_\_\_\_ or by making a \_\_\_\_\_.
11. In both direct and indirect digital radiography a \_\_\_\_\_ is not needed.

12. Because the silver salts found in film emulsion and processing chemicals are not used in digital imaging, there are no \_\_\_\_\_ and \_\_\_\_\_ issues.
13. In direct digital radiography the image appears on the screen \_\_\_\_\_.
14. In direct digital radiography the sensor is thicker and more \_\_\_\_\_ than in indirect digital radiography.
15. The main disadvantage of digital imaging is \_\_\_\_\_.
4. The human eye can discern about
  - a. 9 to 10 gray levels
  - b. 256 gray levels
  - c. 100 gray levels
  - d. 32 gray levels
  - e. 100 gray levels
5. Darkroom and processing capability is needed in
  - a. direct digital radiography
  - b. optical scanning digital radiography
  - c. storage phosphor technique
  - d. indirect digital radiography
  - e. none of the above
6. The most critical part of a digital radiographic system is the
  - a. computer
  - b. printer
  - c. scanner
  - d. sensor
  - e. software

## V. Multiple Choice

Select the best answer.

1. The standard dental x-ray unit
  - a. cannot be used for digital radiography
  - b. is not capable of producing the short exposure time needed for digital radiography
  - c. can be used for digital radiography
  - d. is not capable of producing the long exposures needed
  - e. none of the above
2. The storage phosphor sensor is
  - a. larger than direct sensors
  - b. more rigid than direct sensors
  - c. more sensitive than direct sensors
  - d. thinner than direct sensors
  - e. none of the above
3. The type of digital imaging system that is similar to scanning a document is
  - a. direct digital radiography
  - b. optically scanned digital radiography
  - c. indirect digital radiography
  - d. direct digital scanning
  - e. indirect digital scanning
7. Digital imaging for panoramic units
  - a. is now available
  - b. cannot be done
  - c. is not yet available
  - d. increases the patient exposure
  - e. needs standard processing
8. A "hard copy" is
  - a. a duplicate radiograph
  - b. an image that is hard to acquire
  - c. a computer printout
  - d. a rigid radiograph
  - e. none of the above
9. The digital image has
  - a. 4 to 8 line pairs per millimeter
  - b. 9 to 10 line pairs per millimeter
  - c. 12 to 15 line pairs per millimeter
  - d. 13 to 16 line pairs per millimeter
  - e. 17 to 20 line pairs per millimeter

10. When compared to D-speed film, digital radiography can reduce the patient's exposure by
  - a. 60%
  - b. 90%
  - c. 150%
  - d. 200%
  - e. none of the above
11. In direct digital radiography, a digital image can be generated in anywhere from
  - a. 1 to 3 minutes
  - b. 1.5 to 3 minutes
  - c. 1 to 4 minutes
  - d. 1.5 to 4.5 minutes
  - e. 1.5 to 5 minutes
12. The major difficulty in using direct digital radiography is
  - a. using the bisecting technique
  - b. placing the sensor parallel to the tooth
  - c. patient movement
  - d. time consumed
  - e. radiation exposure
13. Digital images
  - a. can be integrated into an office record system
  - b. can be enlarged
  - c. can be inverted
  - d. can be colorized
  - e. all of the above
14. Digital intraoral sensors are
  - a. autoclavable
  - b. extremely sturdy
  - c. available in only one size
  - d. quite fragile
  - e. none of the above
15. All of the digital imaging systems differ in how they
  - a. acquire the digital image
  - b. transmit the image
  - c. display the image
  - d. adjust the image
  - e. store the image

---

## VI. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

1. The most critical part of a digital radiography system is the sensor that is placed in the patient's mouth. **T/F**
2. A digital image is composed of structurally ordered areas called analogues. **T/F**
3. In a direct digital radiography system, the sensor is connected by a wire to the computer. **T/F**
4. Indirect digital radiography employs the use of storage phosphor plates directly connected to the computer. **T/F**
5. In optically scanned digital radiography systems, regular dental film is used to acquire the image. **T/F**

## Educational Objectives

*After reading Chapter 16 of the textbook and completing this exercise, the student will*

1. Have a basic understanding and appreciation of the basic concepts of computer tomography (CT) scanning and magnetic resonance imaging (MRI).
2. Understand the role of CT and MRI in dentistry.

## I. Definitions

Define/explain the following terms.

1. Axial plane \_\_\_\_\_  
\_\_\_\_\_
2. Bone window \_\_\_\_\_  
\_\_\_\_\_
3. Computed tomography (CT) \_\_\_\_\_  
\_\_\_\_\_
4. CT number \_\_\_\_\_  
\_\_\_\_\_
5. Digitize \_\_\_\_\_  
\_\_\_\_\_
6. Electronic sensor \_\_\_\_\_  
\_\_\_\_\_
7. Hounsfield unit (HU) \_\_\_\_\_  
\_\_\_\_\_
8. Image acquisition \_\_\_\_\_  
\_\_\_\_\_
9. Image reformatting \_\_\_\_\_  
\_\_\_\_\_
10. Magnetic field \_\_\_\_\_  
\_\_\_\_\_

11. Magnetic resonance imaging (MRI) \_\_\_\_\_  
\_\_\_\_\_
12. Radiofrequency waves \_\_\_\_\_  
\_\_\_\_\_
13. Signal intensity \_\_\_\_\_  
\_\_\_\_\_
14. Soft tissue window \_\_\_\_\_  
\_\_\_\_\_
15. Software \_\_\_\_\_  
\_\_\_\_\_

## II. Comprehension Exercise

1. What is the main difference between CT scanning and digital radiography?
2. Explain the advantage of using a CT scan instead of a panoramic film in the planning for implants.
3. What are the common themes employed between CT scanning and MRI?
4. What are CT numbers? Give an example.



5. Why is MRI a preferred method for imaging the articular disc of the temporomandibular joint (TMJ)?
6. Why has the “A” been dropped in “CAT” scan? What major change in the use of this technique is responsible for the alteration?
7. What is a weak signal?
8. What is the function of the powerful magnet in MRI?
9. Explain how a CT scan could be sent to the referring dentist.
10. What does image reformatting mean?
11. List five advantages of CT scanning.

12. How is tomography used in obtaining a CT scan?

13. Why is there no radiation risk to the patient with MRI?

14. List four disadvantages of CT scanning.

---

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

*Column A*

- \_\_\_\_\_ 1. CT number
- \_\_\_\_\_ 2. sagittal cut
- \_\_\_\_\_ 3. powerful magnet
- \_\_\_\_\_ 4. proton density
- \_\_\_\_\_ 5. strong signal
- \_\_\_\_\_ 6. hard copy
- \_\_\_\_\_ 7. radiofrequency waves
- \_\_\_\_\_ 8. implant program
- \_\_\_\_\_ 9. electronic detectors
- \_\_\_\_\_ 10. information storage
- \_\_\_\_\_ 11. software
- \_\_\_\_\_ 12. weak signal
- \_\_\_\_\_ 13. bone window
- \_\_\_\_\_ 14. water content
- \_\_\_\_\_ 15. zero Hounsfield units

*Column B*

- a. directs the computer
- b. hard tissue
- c. Hounsfield units (HU)
- d. signals to computer
- e. 70% of the human body
- f. high density
- g. aligns protons
- h. soft tissue
- i. water
- j. computer
- k. MRI
- l. resonance
- m. given to the patient
- n. long wavelengths
- o. coronal plane
- p. reformatted image
- q. software

## IV. Complete These Statements

1. For proper implant planning using CT scanning a special \_\_\_\_\_ is needed.
2. Seventy percent of the human body is \_\_\_\_\_.
3. CT was introduced into radiology in the early \_\_\_\_\_.
4. Radiofrequency waves and x-rays are part of the \_\_\_\_\_.
5. In CT scanning, the \_\_\_\_\_ is done in a tomographic mode with the detectors traveling 360 degrees around the patient.
6. In CT scanning, the computer collects the x-ray beam penetration data in a grid pattern called a \_\_\_\_\_.
7. A black area on an MR image indicates \_\_\_\_\_.
8. A new means to acquire the CT image is a technique called \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ using a two-dimensional x-ray sensor.
9. CT numbers range from \_\_\_\_\_ to \_\_\_\_\_.
10. Because radiofrequency energy waves are \_\_\_\_\_, they cannot cause ionization.

## V. Multiple Choice

Select the best answer.

1. In MRI the powerful magnetic field in which the patient is placed
  - a. causes ionization of tissue
  - b. produces the signal
  - c. generates the radiofrequency wave
  - d. realigns the tissue protons
  - e. all of the above
2. The CT image can be
  - a. displayed on a monitor
  - b. stored on a disk
  - c. transmitted by phone to other locations
  - d. reformatted in other planes
  - e. all of the above
3. In CT the image is formed by the
  - a. computer
  - b. sensor
  - c. tube movement
  - d. magnetic field
  - e. none of the above
4. Fat tissue has a Hounsfield unit value of
  - a. +1000
  - b. +100
  - c. 0
  - d. -1000
  - e. none of the above
5. The views needed in a CT scan for implant evaluation are
  - a. panoramic and coronal
  - b. coronal
  - c. sagittal
  - d. axial and cross sectional
  - e. all of the above

6. The main application of MRI in dentistry has been in imaging
  - a. bone density
  - b. the maxillary sinus
  - c. the articular disc of the TMJ
  - d. the mental foramen
  - e. none of the above
7. The CT number for water is
  - a. 0Hu
  - b. +1000Hu
  - c. -1000Hu
  - d. +117Hu
  - e. -50Hu
8. In CT scanning, significant artifacts are produced by
  - a. composite restorations
  - b. metallic objects
  - c. dense bone
  - d. static electricity
  - e. excessive bending
9. The radiation dose from a head scan is
  - a. more than one conventional skull film
  - b. the same as one skull film
  - c. less than one skull film
  - d. not comparable
  - e. none of the above
10. The powerful magnetic field in MRI can lethally attract
  - a. the operator
  - b. the patient
  - c. the water molecules
  - d. the receptor
  - e. any freestanding metal objects

## VI. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

1. CT scanning uses ionizing radiation as the energy source. **T/F**
2. Both CT scanning and MRI utilize the tomographic technique in image acquisition. **T/F**
3. Cone beam tomography produces equivalent radiation exposure to the patient when compared to medical CT scanning for dental use. **T/F**
4. Magnetic resonance imaging (MRI) utilizes microwave energy as its source. **T/F**
5. Soft tissues have a strong signal intensity on MRI images and appear as black areas. **T/F**

## Educational Objectives

*After reading Chapter 17 of the textbook and completing this exercise, the student will*

1. Know the steps necessary to uphold a quality assurance program in the dental office in order to ensure radiographs of the highest quality with minimum exposure to the patients and dental personnel.

### I. Definitions

Define/explain the following terms.

1. AAOMR \_\_\_\_\_  
\_\_\_\_\_
2. "Criteria for Intraoral Radiographs" \_\_\_\_\_  
\_\_\_\_\_
3. Darkroom quality assurance program \_\_\_\_\_  
\_\_\_\_\_
4. Lead contamination \_\_\_\_\_  
\_\_\_\_\_
5. Lead-lined boxes \_\_\_\_\_  
\_\_\_\_\_
6. "Longest in, first out" rule \_\_\_\_\_  
\_\_\_\_\_
7. Protective devices \_\_\_\_\_  
\_\_\_\_\_
8. Quality assurance program \_\_\_\_\_  
\_\_\_\_\_
9. Reference film \_\_\_\_\_  
\_\_\_\_\_
10. Step wedge \_\_\_\_\_  
\_\_\_\_\_

---

## II. Comprehension Exercise

1. What comprises the most critical part of the darkroom quality assurance program?
2. List the six categories for quality assurance named by the American Academy of Oral and Maxillofacial Radiology (AAOMR).
3. What items should be posted in the exposure and processing rooms?
4. List/explain two ways to check solution strength in a dental office.
5. Discuss the importance of a quality assurance program in the darkroom.
6. How can an office maintain high levels of chairside competence?

7. List the components of an office quality assurance program that would fall into the realm of responsibility of the dental support team.
8. When should the processing solutions be changed?
9. Discuss the recently identified potential source of lead exposure in the dental office.
10. How can the strength of the fixer be gauged? Explain.

---

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

*Column A*

- \_\_\_\_\_ 1. health physicist
- \_\_\_\_\_ 2. automatic processor
- \_\_\_\_\_ 3. step wedge
- \_\_\_\_\_ 4. optimal darkroom conditions
- \_\_\_\_\_ 5. processing solutions
- \_\_\_\_\_ 6. AAOMR
- \_\_\_\_\_ 7. posting current charts
- \_\_\_\_\_ 8. full fixer strength
- \_\_\_\_\_ 9. monitoring of the x-ray generator
- \_\_\_\_\_ 10. reference film

*Column B*

- a. strength of the solutions
- b. governmental agency
- c. outlined preventive procedures
- d. inspection
- e. films clear in 2 to 3 minutes
- f. density too dark
- g. darkroom schedules
- h. cleaned weekly
- i. predetermined density
- j. solutions are too warm
- k. films clear in 4 to 5 minutes
- l. changed every 2 to 3 weeks
- m. checks for adequate safelighting

## IV. Complete These Statements

1. In the dental office, checks for processing solution strength and levels should be performed \_\_\_\_\_.
2. The dental staff should check the safelighting and light tightness \_\_\_\_\_ depending on the work load.
3. An easy way to check solution strength in a dental office is by comparison with a \_\_\_\_\_ or \_\_\_\_\_ film.
4. The strength of the fixer can be gauged by noting the \_\_\_\_\_ films.
5. The dental \_\_\_\_\_ or \_\_\_\_\_ is most likely to be the person in a dental office that takes most of the radiographs; however, peer review also applies to the \_\_\_\_\_.
6. \_\_\_\_\_ is a plan of action to ensure that the x-ray images will be of the highest quality and there will be minimal exposure to the patients.
7. In the past, unexposed film was kept in the operatory in \_\_\_\_\_ boxes.
8. Solutions should be stored in a \_\_\_\_\_ location in the dental office.
9. A lessening of film density on a processed film indicates a \_\_\_\_\_ solution and signals the need for a change.

10. The " \_\_\_\_\_ " should be followed at all times in an attempt to evaluate the chairside radiographic techniques being employed in a dental office.

## V. Multiple Choice

Select the best answer.

1. Part of the quality assurance program includes maintaining the conditions of protective devices such as
  - a. thyroid collars
  - b. film holders
  - c. lead aprons
  - d. barriers
  - e. all of the above are possible answers
2. The most critical part of a darkroom quality assurance program is
  - a. keeping a log book
  - b. monitoring the chemical strength and level of the processing solutions
  - c. monitoring the condition of the film hangers and clips
  - d. recording darkroom maintenance schedules
  - e. none of the above apply
3. Processing solutions should be changed
  - a. once a month
  - b. twice a week
  - c. every 2 to 3 weeks
  - d. at least weekly
  - e. daily
4. A scientifically controlled way to test the strength of the processing solutions is by use of
  - a. a reference film
  - b. a step wedge
  - c. the coin test
  - d. the time-temperature method
  - e. the hot processing technique



5. If clearing of a film requires more than 4 minutes, the fixer
  - a. is too concentrated
  - b. is too strong
  - c. is acceptable for use
  - d. will be fine after one week
  - e. is too weak
6. Unexposed films should be stored at
  - a. temperatures of 50 to 70° F and 40 to 60 percent relative humidity
  - b. temperatures of 40 to 50° F and 30 to 40 percent relative humidity
  - c. temperatures of 60 to 80° F and 0 to 70 percent relative humidity
  - d. temperatures of 30 to 40° F and 50 to 60 percent relative humidity
  - e. none of the above
7. The lead used to line the lead-lined boxes may oxidize and produce a white lead powder that is about
  - a. 40% lead
  - b. 70% lead
  - c. 10% lead
  - d. 50% lead
  - e. 80% lead
8. For a darkroom quality assurance program to be effective
  - a. the darkroom must be large enough to accommodate the staff
  - b. the darkroom should be used for storage of film
  - c. the viewbox in the darkroom should not be used
  - d. the darkroom must be a darkroom and nothing else
  - e. the thermometer does not have to be accurate
9. In order to use films before their expiration date, one should use
  - a. the rule of "Selection Criteria"
  - b. the "Criteria for Intraoral Radiographs"
  - c. the "longest in, first out" rule
  - d. the "maximum permissible dose"
  - e. the "inverse square law"
10. It usually follows that developer and fixer solutions will need changing
  - a. 1 week apart
  - b. at the same time
  - c. 2 to 3 weeks apart
  - d. 2 days apart
  - e. too often to perform the task at the same time

## VI. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

1. An effective quality assurance (QA) policy that monitors the use of x-radiation in a dental office is the sole responsibility of the dentist. **T/F**
2. Maintaining high levels of chairside competence is the basis of any successful QA program. **T/F**
3. The acronym "CRESO" stands for a Certified Radiation Equipment Safety Officer. **T/F**
4. The chemical strength and level of solutions in both manual tanks and automatic processors must be monitored on a weekly basis. **T/F**
5. Unexposed and unprocessed films, as well as solutions, should be stored in a cold, humid location. **T/F**

# Patient Management and Special Problems

## Educational Objectives

*After reading Chapter 18 of the textbook and completing this exercise, the student will*

1. Understand how to successfully relate to all patients in the dental environment.
2. Understand what special situations might arise in dental radiography and be able to deal with them clinically.
3. Be able to substitute alternative techniques in dental radiography when it is not possible to use the primary method.

## I. Definitions

Define/explain the following terms.

1. Arthrography \_\_\_\_\_  
\_\_\_\_\_
2. Buccal object rule \_\_\_\_\_  
\_\_\_\_\_
3. Disability \_\_\_\_\_  
\_\_\_\_\_
4. Gag reflex \_\_\_\_\_  
\_\_\_\_\_
5. Localization by definition \_\_\_\_\_  
\_\_\_\_\_
6. Marking grid \_\_\_\_\_  
\_\_\_\_\_
7. Maxillary torus \_\_\_\_\_  
\_\_\_\_\_
8. Measuring grid \_\_\_\_\_  
\_\_\_\_\_
9. Radiopaque media \_\_\_\_\_  
\_\_\_\_\_

10. Reverse bitewing \_\_\_\_\_  
\_\_\_\_\_
11. Right-angle occlusal projection \_\_\_\_\_  
\_\_\_\_\_
12. Sialography \_\_\_\_\_  
\_\_\_\_\_
13. Three-plane localization \_\_\_\_\_  
\_\_\_\_\_
14. Trismus \_\_\_\_\_  
\_\_\_\_\_
15. Tube shift \_\_\_\_\_  
\_\_\_\_\_

## II. Comprehension Exercise

1. Explain the role of the dental professional in patient management.
2. Describe personal hygiene and infection control procedures in dental radiography of which the dental professional should be aware.
3. How has greeting a patient in the waiting room changed since the Health Information Privacy Accountability Act (HIPAA) legislation was initiated?

4. How can the dental professional convey a feeling of confidence to the patient?
5. What does one do when a patient refuses to have radiographs taken?
6. What will determine how the disabled patient is managed in the dental office?
7. Why is it important for the dental professional to be able to discuss radiation safety with the patient?
8. List and briefly describe some methods that may be used to prevent gagging.
9. What can the dental professional do if the pediatric patient does not cooperate while trying to take bitewing radiographs?

10. Describe three methods that can be used to localize an impaction.
11. What is the proper film order when taking a full-mouth radiographic survey? Why?
12. What techniques can the operator employ to facilitate placement of the mandibular anterior film when the lingual frenulum presents an anatomic constraint?
13. What are some clinical situations that may make it impossible to take intraoral radiographs?
14. List some methods that might be used to introduce a child to the use of dental x-rays.
15. Explain the use of the “same lingual, opposite buccal” (SLOB) rule in the tube shift localization technique.

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

#### Column A

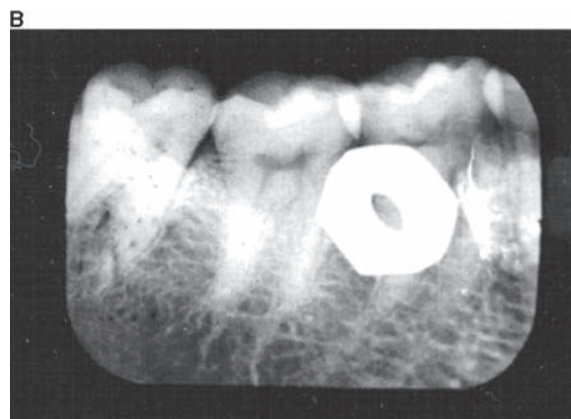
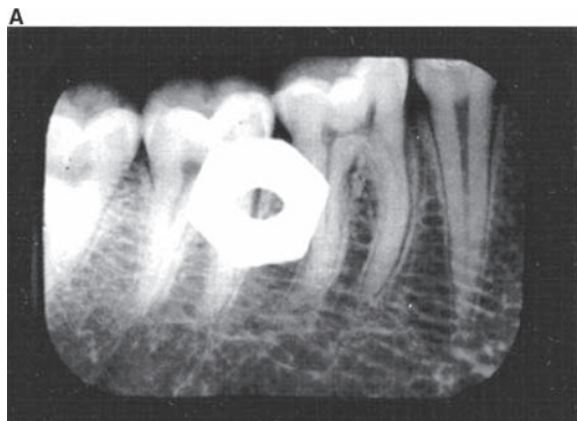
- \_\_\_\_\_ 1. "show and tell"
- \_\_\_\_\_ 2. radiopaque media
- \_\_\_\_\_ 3. definition evaluation
- \_\_\_\_\_ 4. arthrography
- \_\_\_\_\_ 5. shallow palate
- \_\_\_\_\_ 6. SLOB
- \_\_\_\_\_ 7. reverse bitewing
- \_\_\_\_\_ 8. right-angle occlusal
- \_\_\_\_\_ 9. low palatal vault
- \_\_\_\_\_ 10. gagging
- \_\_\_\_\_ 11. grid
- \_\_\_\_\_ 12. cuspid overlap
- \_\_\_\_\_ 13. rubber dam
- \_\_\_\_\_ 14. narrow arch
- \_\_\_\_\_ 15. lingual frenulum

#### Column B

- a. buccal object rule
- b. lateral oblique
- c. horizontal angulation
- d. defensive reflex
- e. change the film size
- f. superimposed structures
- g. temporomandibular joint (TMJ)
- h. bisecting angle technique
- i. gagging
- j. sialogram
- k. increased vertical angulation
- l. tongue tied
- m. pediatric curiosity
- n. endodontic radiographs
- o. topographic occlusal
- p. localization
- q. marking

### IV. Illustrations

1. (Figure 18-1) Radiograph B was taken with an increased distal horizontal angulation from the initial radiograph A. Thus the foreign body must be:
- a. located buccally
  - b. located lingually
  - c. in a location that cannot be determined




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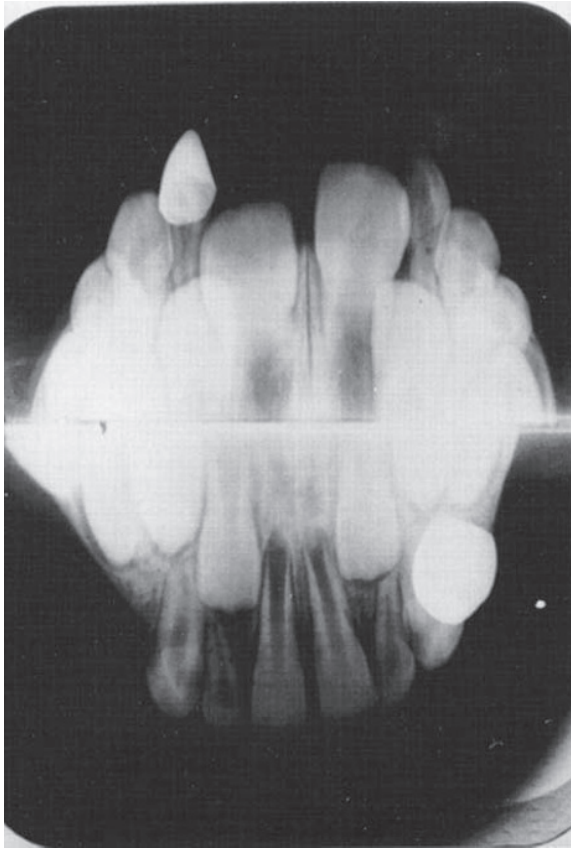


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2. (Figure 18-2) What type of radiograph is this? What would be its use?



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## V. Complete These Statements

1. In localization by definition, the object that is closest to the film has the better \_\_\_\_\_.
2. In taking a full-mouth series, one should always start with the \_\_\_\_\_.
3. \_\_\_\_\_ is a valuable tool in helping dental hygienists and assistants perform their chairside duties.
4. Suggestion, manner, and operator confidence are ways to prevent \_\_\_\_\_.
5. To overcome maxillary cuspid overlap, the angulation is altered \_\_\_\_\_.
6. One of the important roles of the dental professional is to try to \_\_\_\_\_ the patient, so that the work will be easier for everyone involved, including the patient.
7. Magnetic resonance imaging is particularly useful in dentistry in diagnosing pathologic processes of the \_\_\_\_\_.
8. In endodontic radiography it is recommended that the rubber dam be \_\_\_\_\_.
9. If a disabled patient is completely unmanageable, radiographs may have to be taken with the patient under \_\_\_\_\_ or \_\_\_\_\_.
10. Soft tissue can be visualized or outlined on standard radiographs with the use of \_\_\_\_\_.
11. Hand washing and gloving should always be done \_\_\_\_\_ of the patient.
12. The obvious challenge in treating the hearing impaired patient is \_\_\_\_\_.

13. Two clinical situations where it may be impossible to take intraoral radiographs are \_\_\_\_\_ and \_\_\_\_\_.
  14. Two methods that may be used to prevent patient gagging are \_\_\_\_\_ and \_\_\_\_\_.
  15. Less than \_\_\_\_\_ % of dental patients have an impossibly sensitive gag reflex causing radiographic procedures to be completely intolerable.
4. Proper patient management is the responsibility of the
    - a. dentist
    - b. hygienist
    - c. dental assistant
    - d. office manager
    - e. all of the above
  5. If an impacted third molar moves mesially on the second film when the horizontal angulation is increased distally, the impaction must be
    - a. buccal
    - b. on the crest of the ridge
    - c. lingual
    - d. horizontal
    - e. vertical

## VI. Multiple Choice

Select the best answer.

1. The gag reflex is
  - a. an acquired habit
  - b. not present in all patients
  - c. a body defense mechanism
  - d. a contraindication for intraoral radiography
  - e. a reaction the operator can ignore
2. When a patient consistently moves the bitewing packet with the tongue and bites the packet, the operator should
  - a. force the packet into position
  - b. scold the patient
  - c. hold the packet
  - d. do a reverse bitewing
  - e. take no bitewings
3. Dental professionals should never
  - a. use localization techniques
  - b. hold the film in a patient's mouth
  - c. change the size of the film used
  - d. use the bisecting technique
  - e. explain the importance of dental radiographs to the patient
6. The use of patient psychology to manage dental patients includes
  - a. scheduling appointments
  - b. screening telephone calls
  - c. chairside responsibilities
  - d. collecting fees
  - e. all of the above
7. A shallow palate that will not allow proper placement of the film for the paralleling method
  - a. is found very often
  - b. never occurs
  - c. is occasionally found
  - d. requires that a panoramic film be taken
  - e. requires that an occlusal film be taken
8. The lingual frenulum may
  - a. present problems in radiographing the maxillary anteriors
  - b. make it difficult to place the film parallel to the tooth
  - c. prevent the bisecting method from being used
  - d. not affect radiographic technique
  - e. none of the above



9. Possible dental patient disabilities include all of the following *except*
- a. prominent mandibular tori
  - b. hearing impairment
  - c. physical disability
  - d. vision impairment
  - e. developmental disability
10. An impacted mandibular molar can be localized radiographically in the anterior posterior and superior inferior planes by taking
- a. a periapical film
  - b. a panoramic film
  - c. a lateral oblique film
  - d. all of the above
  - e. none of the above
11. Gagging in many cases can be controlled or prevented by
- a. general anesthesia
  - b. use of undiluted mouthwash
  - c. local anesthesia injection
  - d. slower technique
  - e. all of the above
12. In which dental specialty is the marking grid usually employed?
- a. prosthodontics
  - b. periodontics
  - c. pediatric dentistry
  - d. orthodontics
  - e. endodontics
13. In taking mandibular premolar periapical films, mandibular tori
- a. present severe problems using the paralleling method
  - b. have no effect on the paralleling method
  - c. restrict intraoral radiography to occlusal films
  - d. necessitate the use of panoramic technique
  - e. none of the above
14. Which of the following is probably the *least* reliable way to localize an impaction in the buccolingual plane?
- a. localization by definition
  - b. maxillary right-angle occlusal
  - c. right-angle mandibular occlusal
  - d. buccal object rule
  - e. none of the above
15. Sialography involves injecting radiopaque material into
- a. maxillary tori
  - b. salivary glands and ducts
  - c. the lingual frenulum
  - d. the TMJ
  - e. the ventral surface of the tongue

---

## VII. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

1. Patients must feel comfortable and confident about the dental professional's ability to perform the radiographic examination. **T/F**
2. Panoramic radiographs are useful with wheelchair-bound patients. **T/F**
3. Of all the problems one may encounter in intraoral radiography, gagging is probably the least troublesome. **T/F**
4. Structures that lie further from the x-ray film have better radiographic definition than those that lie closer to the film. **T/F**
5. The shallow palatal vault represents a problem in the paralleling technique. **T/F**

# Film Mounting and Radiographic Anatomy

## Educational Objectives

*After reading Chapter 19 of the textbook and completing this exercise, the student will*

1. Understand what determines the radiographic appearance of teeth and the alveolar processes of the maxilla and mandible.
2. Recognize radiographic landmarks of the mandible and maxilla as seen on periapical and bitewing films.
3. Recognize normal radiographic anatomy seen on panoramic and occlusal films.

## I. Definitions

Define/explain the following terms.

1. Curve of Spee \_\_\_\_\_  
\_\_\_\_\_
2. Foramen \_\_\_\_\_  
\_\_\_\_\_
3. Labial mounting \_\_\_\_\_  
\_\_\_\_\_
4. Lingual mounting \_\_\_\_\_  
\_\_\_\_\_
5. Orientation dot \_\_\_\_\_  
\_\_\_\_\_
6. Radiographic anatomy \_\_\_\_\_  
\_\_\_\_\_
7. Radiographic mount \_\_\_\_\_  
\_\_\_\_\_
8. Radiolucent \_\_\_\_\_  
\_\_\_\_\_

9. Radiopaque \_\_\_\_\_

10. Sinus \_\_\_\_\_

## II. Comprehension Exercise

1. What determines whether an object or structure will be radiolucent or radiopaque?
2. Explain how to differentiate between a mandibular premolar and maxillary premolar film.
3. How does the orientation dot help to mount films in their correct anatomic position?
4. Which is the most radiopaque of all tooth structures?
5. Which is the most radiolucent of all tooth structures?

6. Why does the dental professional require a basic knowledge of radiographic anatomy in order to mount films correctly?
7. Radiographically, how can one differentiate mandibular molar edentulous films from maxillary molar edentulous films?
8. How and why do the lips, cheek, and tongue affect the radiograph?
9. What should be labeled on the mount to establish patient ownership of the radiographs?
10. On which extraoral projections can the maxillary sinus be seen? Which is the best view for visualizing the maxillary sinus?
11. On what intraoral projection is the coronoid process of the mandible seen?
12. How are bitewings mounted correctly?

13. Why is the mental foramen seen as a radiolucency?

14. Does the maxilla or the mandible have a denser trabecular pattern of bone? What is the clinical significance of this?

15. How can the dental professional distinguish between a foramen and a periapical pathologic process by means of radiographic interpretation alone?

---

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

*Column A*

- \_\_\_\_\_ 1. coronoid process
- \_\_\_\_\_ 2. internal oblique ridge
- \_\_\_\_\_ 3. lingual mounting
- \_\_\_\_\_ 4. nasopalatine foramen
- \_\_\_\_\_ 5. mandibular foramen
- \_\_\_\_\_ 6. curve of Spee
- \_\_\_\_\_ 7. labial mounting
- \_\_\_\_\_ 8. cementum
- \_\_\_\_\_ 9. zygomatic process of maxilla
- \_\_\_\_\_ 10. nutrient canals
- \_\_\_\_\_ 11. enamel
- \_\_\_\_\_ 12. illuminator
- \_\_\_\_\_ 13. greater radiation penetration
- \_\_\_\_\_ 14. mental foramen
- \_\_\_\_\_ 15. genial tubercle

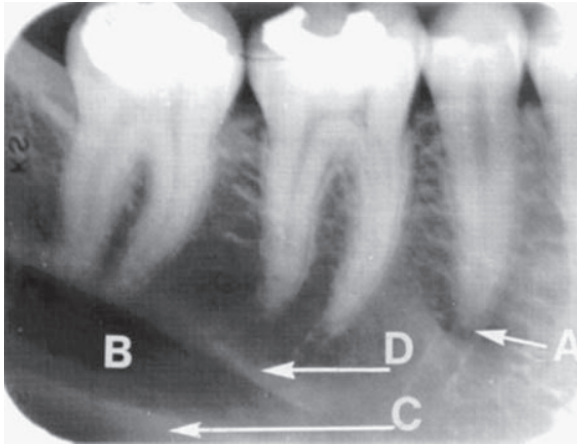
*Column B*

- a. vertical radiolucent lines
- b. viewbox
- c. lower incisor film
- d. most radiopaque tooth structures
- e. radiopaque covering on the root
- f. not seen on a periapical survey
- g. maxillary molar film
- h. patient's right on viewer's left
- i. mylohyoid ridge
- j. mandibular condyle
- k. U-shaped radiopacity
- l. lower premolar film
- m. maxillary incisor film
- n. patient's left on viewer's left
- o. radiolucent
- p. bitewing radiographs
- q. radiopaque band

## IV. Illustrations

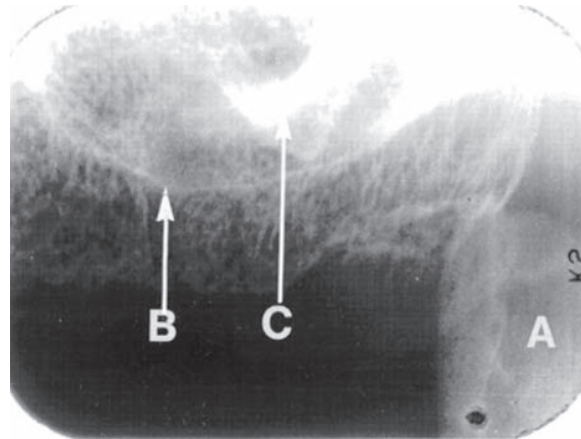
Identify the lettered structures on each of the following radiographs.

1. (Figure 19-1) Identify the labeled structures.



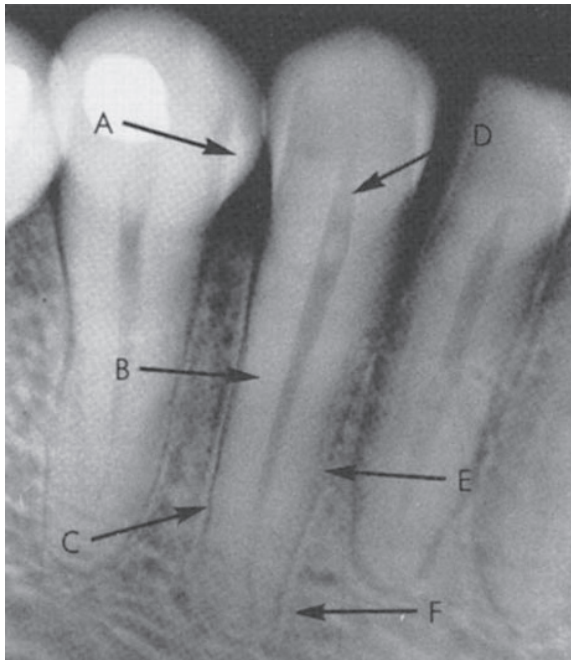
- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_

2. (Figure 19-2) Which intraoral radiographic projection is this? Assuming labial mounting, which side of the mouth is this? Identify the labeled structures.



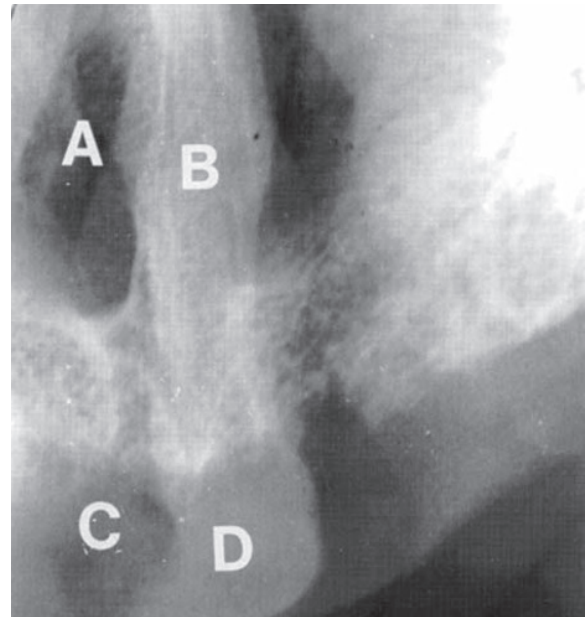
- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_

3. (Figure 19-3) Identify the following structures labeled A through F.



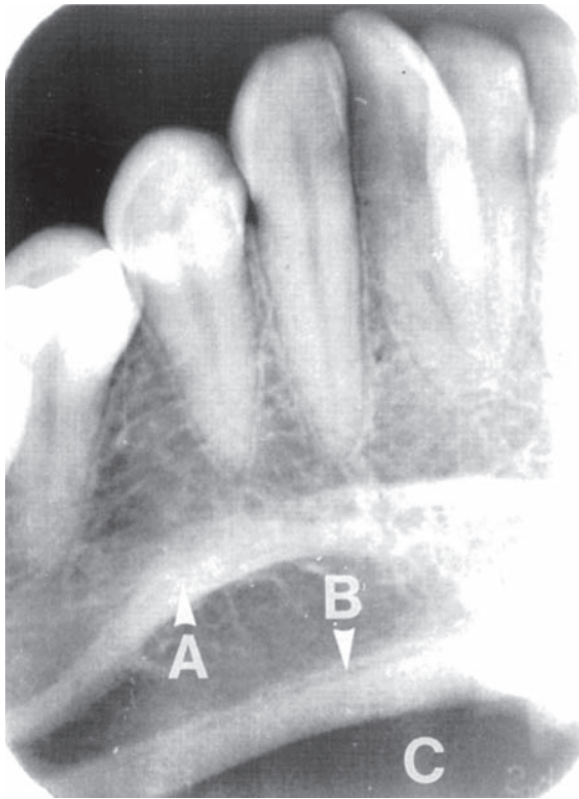
- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_
- e. \_\_\_\_\_
- f. \_\_\_\_\_

4. (Figure 19-4) Which intraoral radiographic projection is this? Identify the labeled structures.



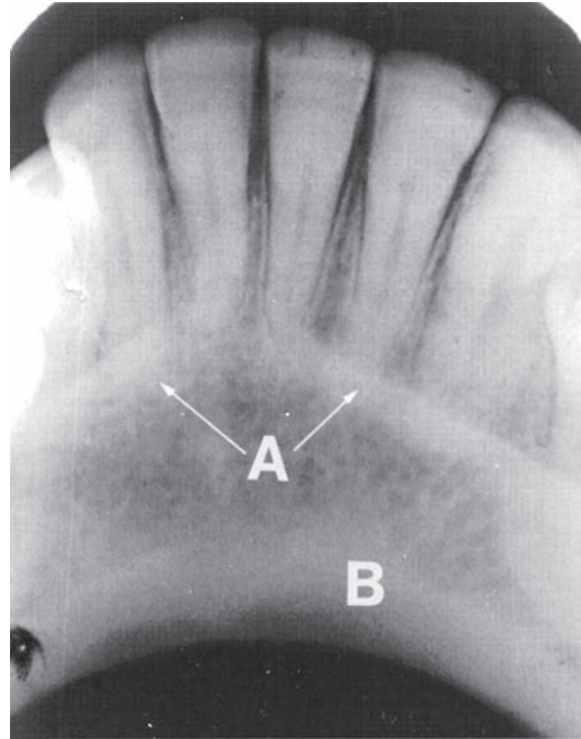
- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_

5. (Figure 19-5) Identify the labeled structures.



- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_

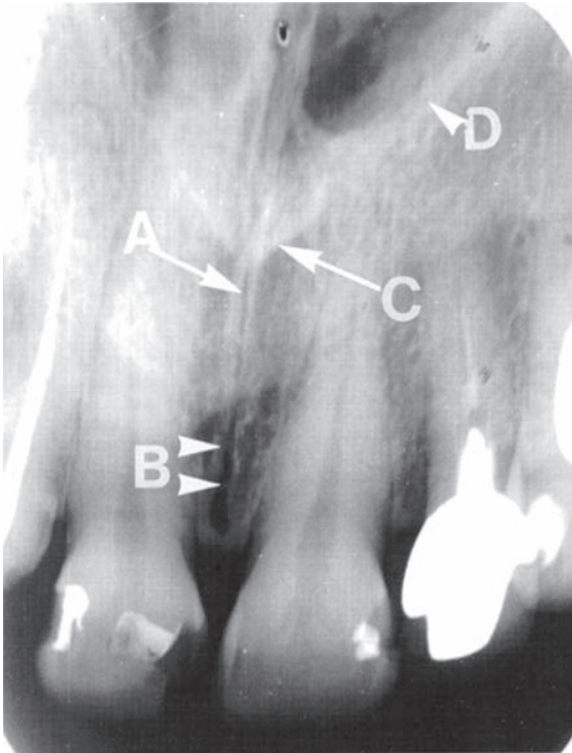
6. (Figure 19-6) Identify structures A and B.



- a. \_\_\_\_\_
- b. \_\_\_\_\_

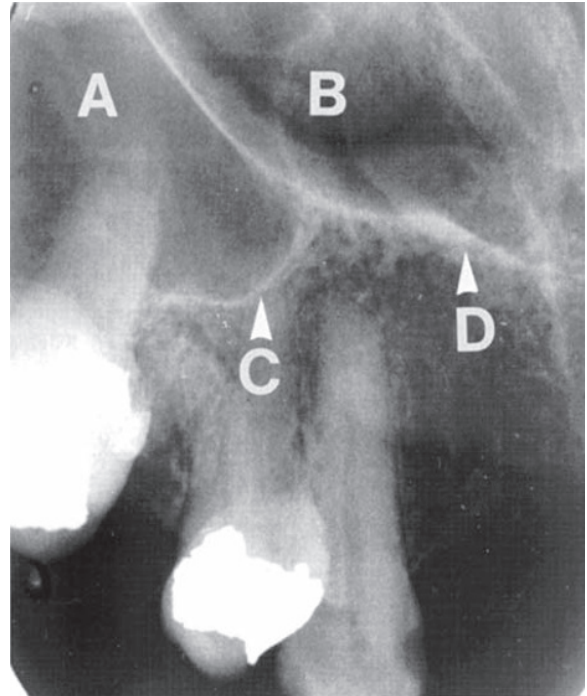


7. (Figure 19-7) Identify the labeled structures.



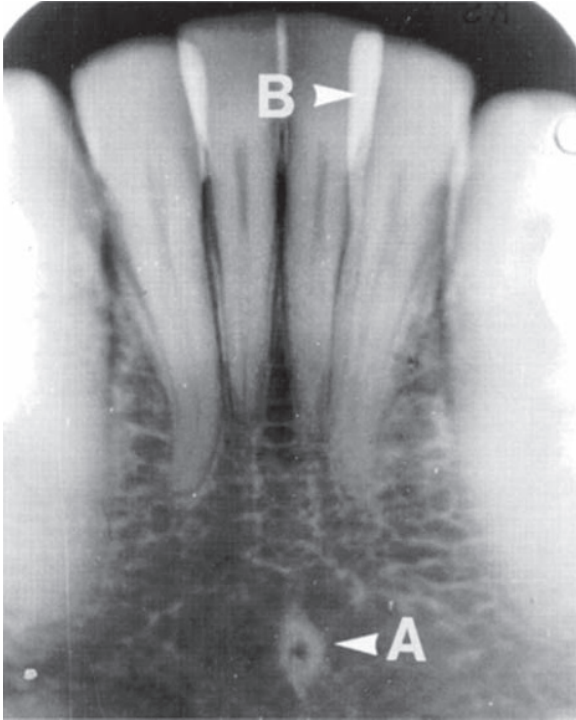
- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_

8. (Figure 19-8) Identify the labeled structures.



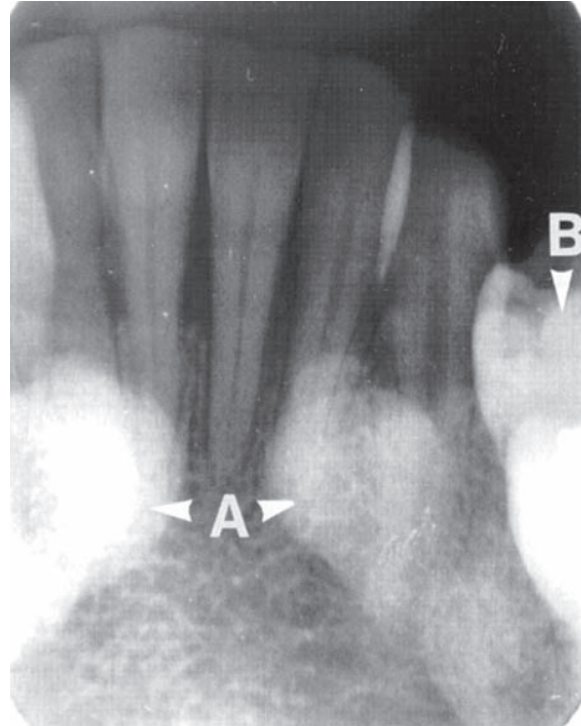
- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_

9. (Figure 19-9) Identify A and B.



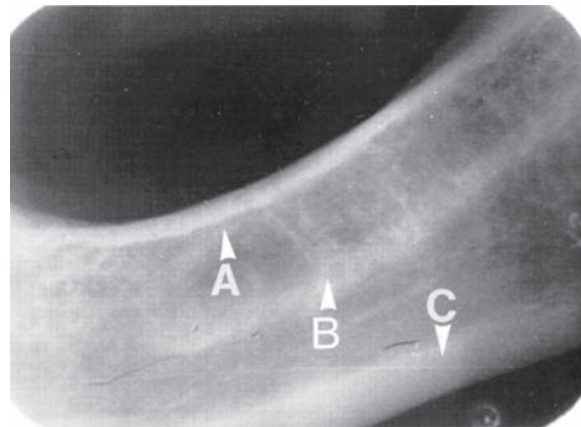
- a. \_\_\_\_\_  
b. \_\_\_\_\_

10. (Figure 19-10) Identify A and B.



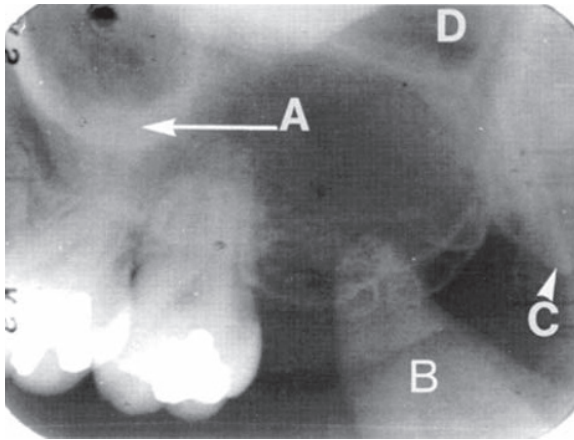
- a. \_\_\_\_\_  
b. \_\_\_\_\_

11. (Figure 19-11) What radiographic view is this? Assuming labial mounting, is it the patient's right or left? Identify the labeled structures.



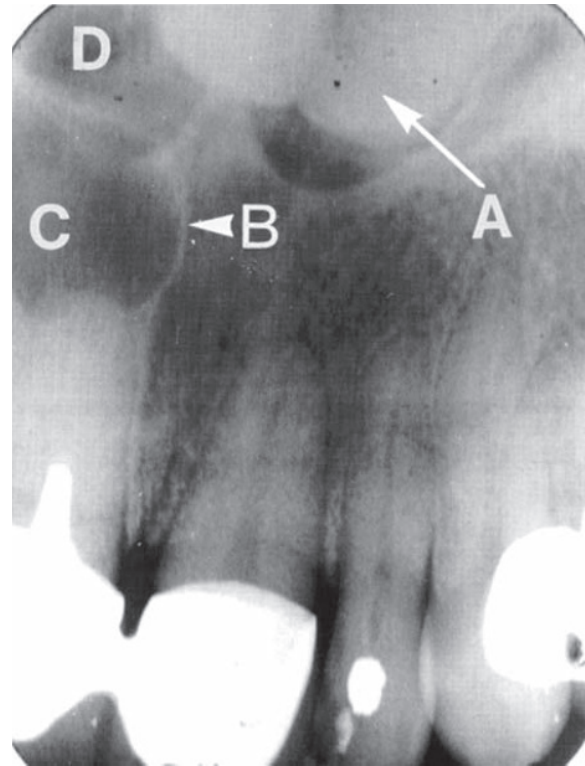
- a. \_\_\_\_\_  
b. \_\_\_\_\_  
c. \_\_\_\_\_

12. (Figure 19-12) Identify the labeled structures.



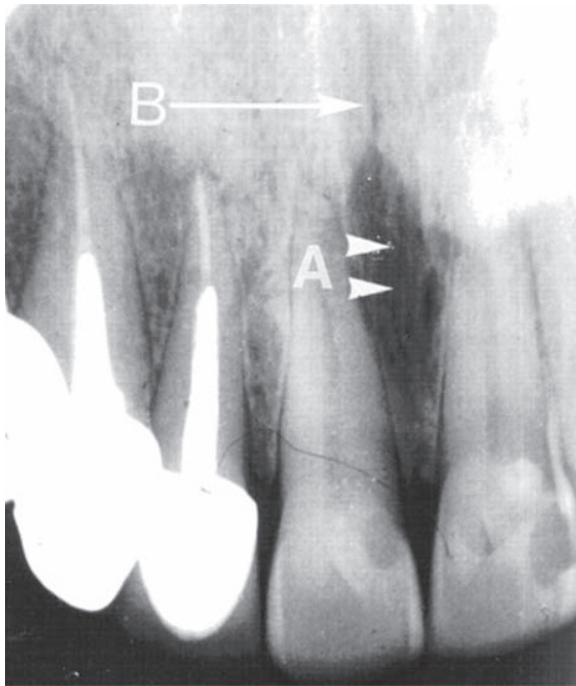
- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_

13. (Figure 19-13) Identify the labeled structures.



- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_

14. (Figure 19-14) Identify A and B.



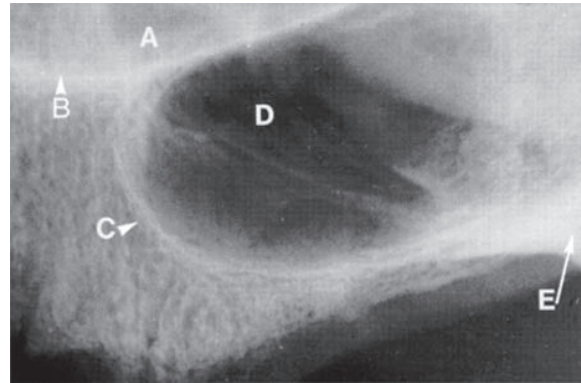
- a. \_\_\_\_\_  
b. \_\_\_\_\_

15. (Figure 19-15) All teeth test vital. What is your interpretation of the radiolucency at the apex of the second premolar?



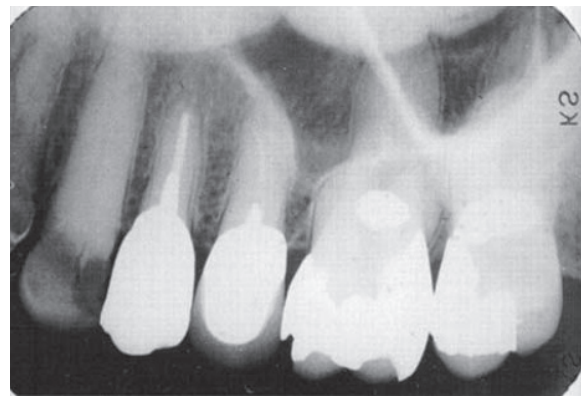
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

16. (Figure 19-16) Assuming labial mounting, what side (left or right) and area does this radiograph show? Identify the labeled structures.



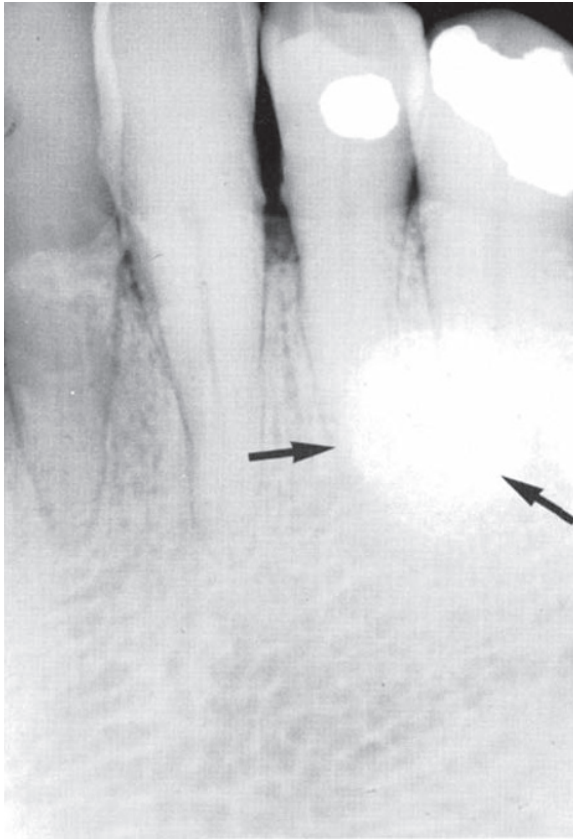
- a. \_\_\_\_\_  
b. \_\_\_\_\_  
c. \_\_\_\_\_  
d. \_\_\_\_\_  
e. \_\_\_\_\_

17. (Figure 19-17) Identify the dense bony structure seen at the top of this radiograph.



\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

18. (Figure 19-18) Identify the dense area of bone outlined by the arrows.



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## V. Complete These Statements

- The most universally accepted way to mount radiographs is the \_\_\_\_\_ method.
- The mandibular canal can usually be seen on the \_\_\_\_\_ and periapical \_\_\_\_\_ radiographs.
- When mounting it is important to remember that most roots curve \_\_\_\_\_.
- The mental foramen, when it is superimposed on the apex of the premolar, can resemble \_\_\_\_\_.
- The most radiopaque of all tooth structures is \_\_\_\_\_.
- Cancellous bone radiographically is composed of small radiolucent compartments known as \_\_\_\_\_ separated by a radiopaque honeycomb pattern called \_\_\_\_\_.
- A cement base under a deep restoration will appear \_\_\_\_\_ on a radiograph.
- An acrylic crown will appear \_\_\_\_\_ on a radiograph.
- The \_\_\_\_\_ is a depression in the labial plate in the maxillary lateral incisor area.
- The nasal cavity may be seen on a \_\_\_\_\_ and a \_\_\_\_\_ periapical radiograph.
- Roots of the maxillary molars can seem to be in the \_\_\_\_\_ when seen on radiographs.
- The \_\_\_\_\_ is seen as a radiolucent area below the mylohyoid ridge.
- Maxillary premolars usually have \_\_\_\_\_ root(s) whereas mandibular premolars have \_\_\_\_\_ root(s).



14. Metallic restorations will appear \_\_\_\_\_ on radiographs.
15. When interpreting occlusal films, the dental professional must remember that the projection is in the \_\_\_\_\_ plane.
4. Which of the following anatomic structures is usually not demonstrated on intraoral periapical radiographs?
  - a. mental foramen
  - b. mylohyoid ridge
  - c. coronoid process
  - d. mandibular foramen
  - e. median palatine suture

## VI. Multiple Choice

1. The periodontal ligament surrounding a normal tooth appears radiographically as
  - a. an unbroken radiopaque line around the tooth root
  - b. a radiopaque line on the lateral sides of the root
  - c. an unbroken radiolucent line around the tooth root
  - d. a radiolucent line around the apical portion only
  - e. an unbroken radiolucent outline around the crown and root
2. Which of the following structures appear radiolucent on a radiograph?
  - a. nares, median suture, medullary spaces
  - b. incisive canal, genial tubercles, nasal fossa
  - c. maxillary sinus, mylohyoid ridge, mental foramen
  - d. hamular process, nutrient canals, nasal cartilage
  - e. coronoid process, mandibular canal, maxillary septum
3. Which of the following is a major part of the tooth structure, appears radiopaque on radiographs, and is seen in both the crown and roots of the teeth?
  - a. enamel
  - b. cementum
  - c. lamina dura
  - d. dentin
  - e. pulp
5. Arrange the following in order of increasing opacity
  - a. dentin
  - b. enamel
  - c. amalgam
  - d. zinc oxide–eugenol
  - e. pulp
  - (1) c, b, a, e, d
  - (2) d, e, c, a, b
  - (3) e, a, b, d, c
  - (4) e, d, a, b, c
6. All of the following tooth structures appear radiopaque *except*
  - a. enamel
  - b. periodontal membrane
  - c. lamina dura
  - d. cementum
  - e. dentin
7. Which of the following structures appear radiopaque on a radiograph?
  - a. maxillary sinus, genial tubercle, nasal cavity
  - b. nasal spine, external oblique ridge, mental foramen
  - c. internal oblique ridge, median nasal septum, mental ridge
  - d. inferior border of mandible, mental ridge, nares
  - e. maxillary tuberosity, nasopalatine foramen, maxillary sinus
8. All of the following may be seen on a mandibular molar film *except*
  - a. the mandibular canal
  - b. the inferior border
  - c. the condyle
  - d. the internal oblique ridge
  - e. the external oblique ridge

9. The occlusal part of the alveolar bone is referred to as the
  - a. trabeculae
  - b. lamina dura
  - c. alveolar crest
  - d. medullary spaces
  - e. cancellous bone
10. Which of the following appears radiolucent on a radiograph?
  - a. nasal turbinates
  - b. nasal floor
  - c. nasal septum
  - d. nasal cavity
  - e. nasal spine
11. All of the following may be seen on a maxillary premolar radiograph *except*
  - a. the floor of the nose
  - b. the buccinator shadow
  - c. the maxillary sinus
  - d. the maxillary tuberosity
  - e. the zygomatic process of the maxilla
12. The radiolucent anatomic structure seen running vertically between the roots of the maxillary central incisors is the
  - a. nasopalatine foramen
  - b. incisive foramen
  - c. nasal septum
  - d. median palatine suture
  - e. anterior nasal spine
13. Which of the following structures seen on a panoramic radiograph do not appear on an intraoral full-mouth survey?
  - a. the inferior border of the mandible
  - b. the maxillary tuberosity
  - c. the coronoid process
  - d. the hyoid bone
  - e. the mandibular canal
14. The bilateral radiolucent band seen crossing the ascending ramus of the mandible on panoramic films represents
  - a. the hard palate
  - b. the soft palate
  - c. the pharyngeal air space
  - d. the nares
  - e. the uvula
15. Which of the following can be seen on any mandibular radiograph?
  - a. inferior border of the mandible
  - b. external oblique ridge
  - c. genial tubercles
  - d. mental ridges
  - e. mandibular canal

---

## VII. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

1. All radiographic structures appear either radiopaque (RO) or radiolucent (RL) without gradations in each category. **T/F**
2. Not all anatomic landmarks are always demonstrated on every full-mouth survey or individual films. **T/F**
3. It is not difficult to distinguish cementum from dentin on a radiograph. **T/F**
4. Most roots curve mesially. **T/F**
5. Nutrient canals are most easily seen in the mandibular anterior region. **T/F**

# Principles of Radiographic Interpretation

## Educational Objectives

*After reading Chapter 20 of the textbook and completing this exercise, the student will*

1. Understand the steps to be taken in interpreting radiographs and their importance in establishing a diagnosis.

## I. Definitions

Define/explain the following terms.

1. Anatomic landmark \_\_\_\_\_  
\_\_\_\_\_
2. Benign lesion \_\_\_\_\_  
\_\_\_\_\_
3. Bilateral lesion \_\_\_\_\_  
\_\_\_\_\_
4. Differential diagnosis \_\_\_\_\_  
\_\_\_\_\_
5. Interpretation \_\_\_\_\_  
\_\_\_\_\_
6. Malignant lesion \_\_\_\_\_  
\_\_\_\_\_
7. Radiolucent image \_\_\_\_\_  
\_\_\_\_\_
8. Radiopaque image \_\_\_\_\_  
\_\_\_\_\_
9. Unilateral lesion \_\_\_\_\_  
\_\_\_\_\_
10. Vitality testing \_\_\_\_\_  
\_\_\_\_\_



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## II. Comprehension Exercise

1. Why are the borders of a lesion important?
2. What are the three steps to be taken when interpreting dental radiographs?
3. What is considered advanced imaging?
4. Why is it important to the interpretation process for the dental professional to avoid committing technical exposure and processing errors?
5. When should a diagnostician order advanced studies?
6. Why should the dental professional ask a patient to reveal his or her chief complaint?

7. What is the importance of previous films?

8. What is the importance of seeing a suspicious oral lesion on three planes?

9. What is the significance of a lesion that appears bilaterally?

10. Why is it important to visualize dentulous as well as edentulous areas on radiographs?

---

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

*Column A*

- \_\_\_\_\_ 1. edentulous films
- \_\_\_\_\_ 2. anatomic landmarks
- \_\_\_\_\_ 3. buccal plate intact
- \_\_\_\_\_ 4. horizontal overlap
- \_\_\_\_\_ 5. root resorption
- \_\_\_\_\_ 6. teeth movement
- \_\_\_\_\_ 7. interpretation
- \_\_\_\_\_ 8. distinct borders
- \_\_\_\_\_ 9. median palatine cyst
- \_\_\_\_\_ 10. diagnosis

*Column B*

- a. third-dimension visualization
- b. an explanation
- c. located in the maxilla
- d. identification of disease
- e. cyst
- f. within normal limits
- g. benign lesion
- h. faulty operator technique
- i. should be taken
- j. malignancy
- k. advanced imaging
- l. periapical radiograph

## IV. Complete These Statements

1. Previous films are important because they \_\_\_\_\_.
2. To produce adequate diagnostic films, the operator should know \_\_\_\_\_.
3. Most bone lesions are \_\_\_\_\_.
4. Approximately \_\_\_\_\_ % of all pathologic oral conditions are the result of nonvital teeth.
5. One must see all of the \_\_\_\_\_ of a lesion.
6. \_\_\_\_\_ are located in very specific areas in the oral cavity and are diagnostically within normal limits.
7. Poorly defined borders of a lesion are usually seen in \_\_\_\_\_ lesions.
8. A lesion is considered \_\_\_\_\_ if it has one compartment and \_\_\_\_\_ if there is more than one compartment.
9. An area that is \_\_\_\_\_ should be radiographed in order to examine the area for impaction, unerupted teeth, and bone pathologic processes.
10. Rapidly growing lesions that do not have distinct borders are usually \_\_\_\_\_ lesions.

## V. Multiple Choice

Select the best answer.

1. An example of an anatomic landmark resembling a periapical pathology (PAP) is the
  - a. zygomatic arch
  - b. nasopalatine foramen
  - c. internal oblique ridge
  - d. external oblique ridge
  - e. anterior nasal spine
2. The interpretation of radiographs primarily provides the basis for building a
  - a. chief complaint
  - b. diagnosis
  - c. prevention plan
  - d. treatment plan
  - e. dental history
3. The patient's chief complaint may be
  - a. swelling
  - b. pain
  - c. loose teeth
  - d. bleeding
  - e. all of the above
4. Which of the following is *not* a step that is to be taken in building a diagnosis?
  - a. interpretation of what has been identified
  - b. identification of an area or structure that is questionable
  - c. diagnosis based on the interpretation
  - d. extraction of a tooth that is symptomatic
  - e. distinguishing an anatomic landmark from a pathologic lesion
5. A dental professional may want to use CT scanning
  - a. for visualizing the articulator disc
  - b. for cross-sectional views
  - c. for evaluating previous fillings
  - d. instead of a panoramic radiograph
  - e. to evaluate the overlapping of teeth

6. Dental professionals should develop the skills to
  - a. identify all normal anatomy
  - b. identify tooth structure
  - c. identify bone structure
  - d. identify artifacts
  - e. all of the above
7. A rapidly growing, radiolucent lesion with irregular borders in the oral cavity could be a sign of
  - a. a cyst
  - b. an infectious lesion
  - c. a devitalized defect
  - d. a malignancy
  - e. an anatomic landmark
8. Possible pathologic lesions should be described by
  - a. size
  - b. tooth movement
  - c. bone resorption
  - d. root resorption
  - e. all of the above
9. Most lesions in the oral cavity are
  - a. radiopaque
  - b. radiolucent
  - c. both radiolucent and radiopaque
  - d. it depends on whether it is within normal limits or not
  - e. only visible on panoramic radiographs
10. Other signs and symptoms that can be used in establishing a diagnosis along with radiographic interpretation are
  - a. the patient's chief complaint
  - b. biopsy
  - c. medical history
  - d. clinical examination
  - e. all of the above

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## VI. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

1. Interpretation of the radiographs is the only step necessary in formulating a diagnosis. **T/F**
2. To produce adequate diagnostic films, the dental professional must know what relevant information is being sought from the radiograph. **T/F**
3. About 70% of all pathologic conditions seen in the jaws are the result of nonvital teeth and their sequelae. **T/F**
4. Most bilateral findings are normal anatomic landmarks. **T/F**
5. Malignant lesions tend to grow slowly. **T/F**

# Caries and Periodontal Disease

## Educational Objectives

*After reading Chapter 21 of the textbook and completing this exercise, the student will*

1. Understand the effect of caries and periodontal disease on the radiographic appearance of teeth and alveolar bone.
2. Be able to recognize caries on radiographs, correlate clinical findings with radiographic findings, differentiate caries from anatomic features and restorative materials, and be able to judge the extent of caries.
3. Be able to recognize the limitations of radiographs in caries detection.
4. Be able to recognize the signs of periodontal disease on radiographs.
5. Be able to diagnose the extent of bone loss and identify predisposing factors.

## I. Definitions

Define/explain the following terms.

1. Abrasion \_\_\_\_\_  
\_\_\_\_\_
2. Advanced caries \_\_\_\_\_  
\_\_\_\_\_
3. Attrition \_\_\_\_\_  
\_\_\_\_\_
4. Carious exposure \_\_\_\_\_  
\_\_\_\_\_
5. Cemento-enamel junction \_\_\_\_\_  
\_\_\_\_\_
6. Cervical burnout \_\_\_\_\_  
\_\_\_\_\_
7. Composite filling material \_\_\_\_\_  
\_\_\_\_\_
8. Gingivitis \_\_\_\_\_  
\_\_\_\_\_

9. Incipient caries \_\_\_\_\_  
\_\_\_\_\_
10. Indirect pulp capping \_\_\_\_\_  
\_\_\_\_\_
11. Interproximal bone loss \_\_\_\_\_  
\_\_\_\_\_
12. Interproximal overlapped film \_\_\_\_\_  
\_\_\_\_\_
13. Occlusal caries \_\_\_\_\_  
\_\_\_\_\_
14. Periodontal disease \_\_\_\_\_  
\_\_\_\_\_
15. Pulpotomy \_\_\_\_\_  
\_\_\_\_\_

## II. Comprehension Exercise

1. Explain the role of the dental professional in dental diagnosis.
2. Give an example of how an error in radiographic technique can lead to a deficient diagnosis.
3. Explain how caries appears on radiographs initially and as it progresses.

4. Why does caries appear radiolucent on radiographs?
5. Name some conditions found on radiographs that might be misinterpreted as caries.
6. What is the best way to detect occlusal caries?
7. Why is it difficult to see buccal or lingual caries on radiographs?
8. Name some predisposing factors to periodontal disease that can be seen on radiographs.
9. What oral conditions are bitewing radiographs especially useful in detecting?
10. Describe the appearance of calculus on radiographs. Is it always seen radiographically?

11. Why are buccal and lingual caries difficult to detect on radiographs?
12. What are the radiographic signs of early periodontal disease?
13. What are the radiographic signs of advanced periodontal disease?
14. What radiographic exposure technique is preferred for identifying periodontal disease radiographically? Explain.
15. Explain the radiographic finding of “cervical burnout.”



### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

#### *Column A*

- \_\_\_\_\_ 1. periodontal ligament space
- \_\_\_\_\_ 2. resembles periapical pathology
- \_\_\_\_\_ 3. lamina dura
- \_\_\_\_\_ 4. bisecting technique
- \_\_\_\_\_ 5. nonpenetration of photons
- \_\_\_\_\_ 6. calculus
- \_\_\_\_\_ 7. not seen on radiographs
- \_\_\_\_\_ 8. early periodontal disease
- \_\_\_\_\_ 9. radiolucent
- \_\_\_\_\_ 10. advanced periodontal disease
- \_\_\_\_\_ 11. short roots
- \_\_\_\_\_ 12. photons penetrate object
- \_\_\_\_\_ 13. interproximal caries
- \_\_\_\_\_ 14. mistaken for caries
- \_\_\_\_\_ 15. poor way to see caries

#### *Column B*

- a. radiopaque
- b. triangulation
- c. bifurcation involvement
- d. thin radiolucent line
- e. buccal caries
- f. cervical burnout
- g. gingivitis
- h. radiolucent
- i. bitewing film
- j. thin radiopaque line
- k. panoramic films
- l. etiologic factor for periodontitis
- m. dimensional distortion
- n. mental foramen
- o. poor prognosis
- p. acrylic
- q. occlusal film

### IV. Illustrations

1. (Figure 21-1) Identify the caries on this radiograph.




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2. (Figure 21-2) Identify the caries on this radiograph.




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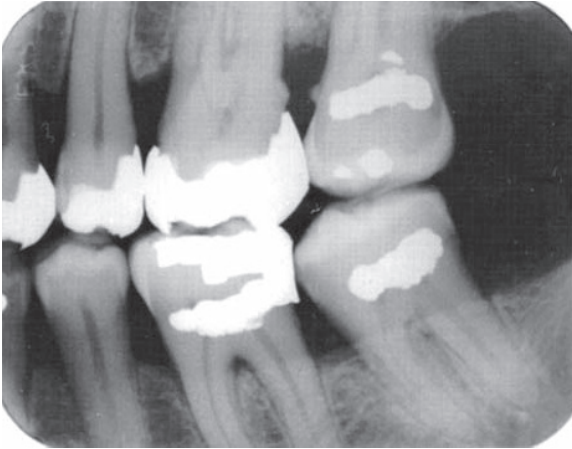


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3. (Figure 21-3) How would you classify the periodontal bone condition on this radiograph?

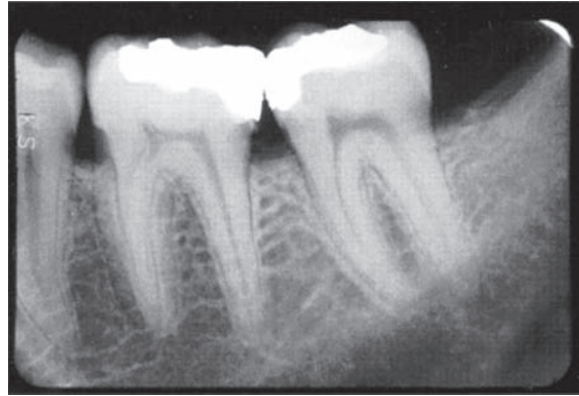


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5. (Figure 21-5) Differentiate between the cervical radiolucencies seen on the mesial and distal surfaces of the first molar. How would you confirm your radiographic diagnosis?

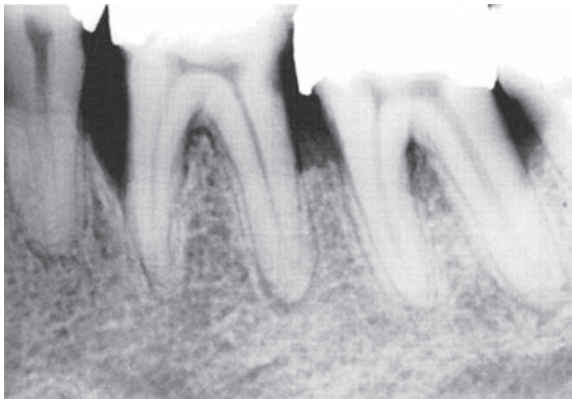


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4. (Figure 21-4) What periodontal conditions appear on this radiograph?

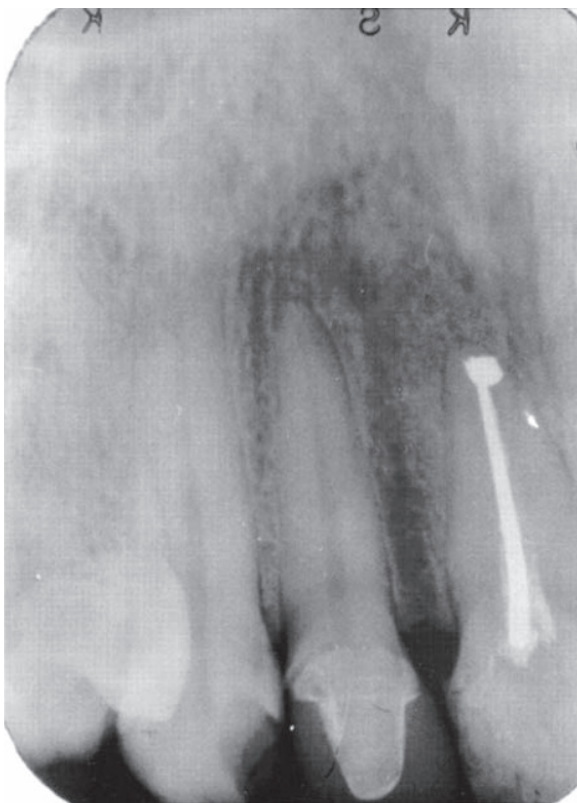


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6. (Figure 21-6) What is your interpretation of the radiolucent area seen on the mesial of the canine (cuspid)?




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7. (Figure 21-7) Identify the caries, if any, on this radiograph.

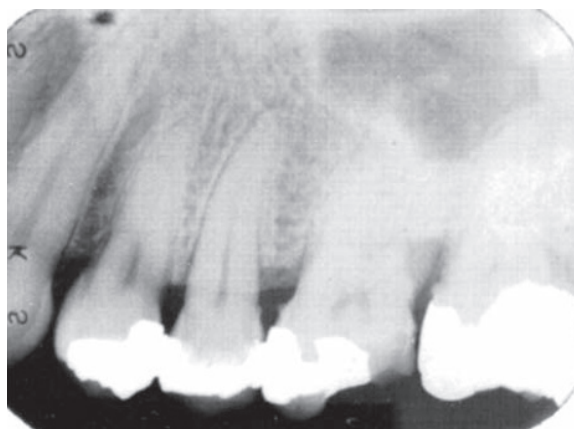



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8. (Figure 21-8) What type of periodontal bone change appears on this radiograph?




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9. (Figure 21-9) Locate the calculus on this radiograph.



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10. (Figure 21-10) Locate the caries on this radiograph.



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11. (Figure 21-11) How would you classify the periodontal condition shown here? What is the prognosis?



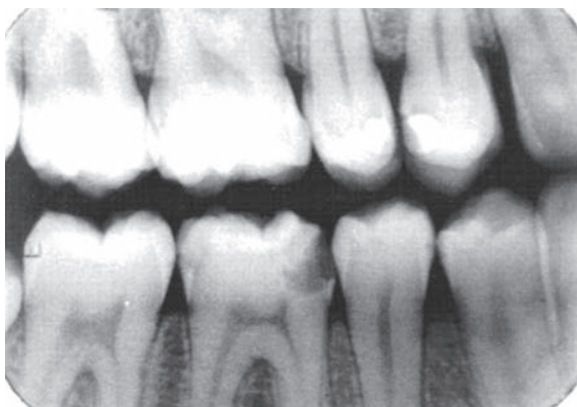
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12. (Figure 21-12) Identify the caries in this radiograph.




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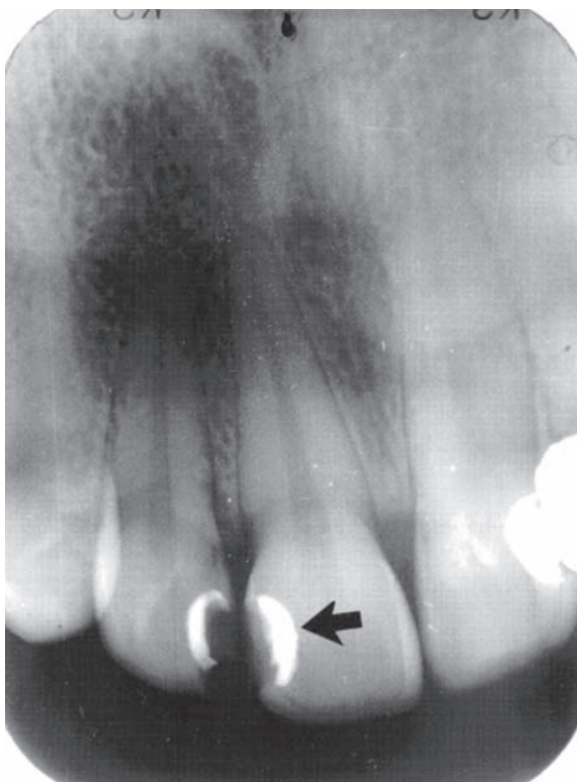


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13. (Figure 21-13) Identify the radiopaque area pointed out by the arrow.




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## V. Complete These Statements

After the following terms, record whether they appear radiopaque (RO) or radiolucent (RL) on radiographs.

1. amalgam filling \_\_\_\_\_
2. lamina dura \_\_\_\_\_
3. periodontal ligament space \_\_\_\_\_
4. old composite restoration \_\_\_\_\_
5. indirect pulp capping \_\_\_\_\_
6. caries \_\_\_\_\_
7. pulp chamber \_\_\_\_\_
8. mental foramen \_\_\_\_\_
9. infrabony pocket \_\_\_\_\_
10. alveolar bone \_\_\_\_\_
11. porcelain crown \_\_\_\_\_
12. pulp canal \_\_\_\_\_
13. cement base under filling \_\_\_\_\_
14. cervical abrasion \_\_\_\_\_
15. calculus \_\_\_\_\_

## VI. Multiple Choice

Select the best answer.

1. The best intraoral radiographic projection for detecting caries is
  - a. the bitewing
  - b. periapical using the paralleling technique
  - c. panoramic
  - d. a and b
  - e. all of the above

2. Radiographic changes evident in gingivitis include
  - a. a widened lamina dura
  - b. loss of interdental supporting bone
  - c. furcation involvement
  - d. both a and b
  - e. none of the above
3. The most common reason for taking dental radiographs is the detection of
  - a. horizontal bone loss
  - b. vertical bone loss
  - c. caries
  - d. faulty restorations
  - e. none of the above
4. The most likely diagnosis of an interproximal radiolucency just above the cervical line on a clinically caries-negative tooth is
  - a. incipient caries
  - b. attrition
  - c. erosion
  - d. cervical burnout
  - e. none of the above
5. It is difficult to visualize buccal caries radiographically because
  - a. the x-ray photons do not penetrate
  - b. of overlying normal structures
  - c. of increased density
  - d. of decreased density
  - e. none of the above
6. Calcified supragingival calculus on the lingual surfaces of teeth is not seen clearly on a radiograph because
  - a. it is more detectable on the buccal surface
  - b. of superimposition of tooth structure
  - c. it is radiolucent
  - d. it is not necessary for periodontal diagnosis
  - e. all of the above
7. Gingival recession is not detectable radiographically because
  - a. the angulation is wrong
  - b. soft tissue is not seen
  - c. the recession is out of the field
  - d. an increased kVp would be needed
  - e. none of the above
8. Cup-shaped bony defects are seen radiographically in
  - a. the early stages of periodontal disease
  - b. the advanced stages of periodontal disease
  - c. the stage of periodontal disease associated with abscesses only
  - d. early gingivitis
  - e. none of the above
9. When caries invades the dentin from the enamel, it is seen as
  - a. a radiopacity
  - b. advancing straight toward the pulp
  - c. spreading laterally and then advancing toward the pulp
  - d. calcifying
  - e. none of the above
10. As for periodontal prognosis, teeth that have anatomically short roots will
  - a. have a poorer prognosis
  - b. have a better prognosis
  - c. be more resistant
  - d. be less resistant
  - e. none of the above
11. The infrabony pocket is seen with
  - a. horizontal bone loss
  - b. gingivitis
  - c. poor crown-root ratio
  - d. vertical bone loss
  - e. none of the above
12. The crown-root ratio as seen on radiographs becomes critical in
  - a. caries detection
  - b. the choice of amalgam or composite for restorations
  - c. designating abutments for a fixed bridge
  - d. periodontal probing
  - e. none of the above

13. In the clinical setting, caries seen radiographically is almost always
  - a. less advanced
  - b. missing
  - c. further advanced
  - d. calcified
  - e. none of the above
14. The type of caries best detected on radiographs is
  - a. occlusal caries
  - b. buccal caries
  - c. cervical caries
  - d. interproximal caries
  - e. none of the above
15. All of the following can resemble caries radiographically *except*
  - a. attrition
  - b. abrasion
  - c. amalgam restorations
  - d. composite restorations
  - e. none of the above

---

## VII. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

1. Detection of caries is probably the most common reason for taking dental radiographs. **T/F**
2. Incipient caries is not difficult to detect radiographically. **T/F**
3. The first radiographic sign of interproximal caries is a notching of the enamel, usually just below the contact point. **T/F**
4. Evaluating the width of the periodontal ligament space is an important component of a radiographic periodontal examination. **T/F**
5. Triangulation of the periodontal membrane is seen radiographically in the advanced stages of periodontal disease. **T/F**

# Pulpal and Periapical Lesions

## Educational Objectives

*After reading Chapter 22 of the textbook and completing this exercise, the student will*

1. Understand the process and sequelae of pulp necrosis and its radiographic findings.
2. Be able to diagnose radiographically periapical pathology and differentiate between it and normal anatomy as well as other apical findings.

## I. Definitions

Define/explain the following terms.

1. Condensing osteitis \_\_\_\_\_  
\_\_\_\_\_
2. Dentoalveolar abscess \_\_\_\_\_  
\_\_\_\_\_
3. External resorption \_\_\_\_\_  
\_\_\_\_\_
4. Internal resorption \_\_\_\_\_  
\_\_\_\_\_
5. Periapical cemental dysplasia (PCD) (Periapical cemental osseous dysplasia [PCOD])  
\_\_\_\_\_  
\_\_\_\_\_
6. Periapical cyst \_\_\_\_\_  
\_\_\_\_\_
7. Periapical granuloma \_\_\_\_\_  
\_\_\_\_\_
8. Periapical pathology \_\_\_\_\_  
\_\_\_\_\_
9. Pulp calcification \_\_\_\_\_  
\_\_\_\_\_



10. Pulp denticle \_\_\_\_\_  
\_\_\_\_\_
11. Pulpitis \_\_\_\_\_  
\_\_\_\_\_
12. Residual cyst \_\_\_\_\_  
\_\_\_\_\_
13. Residual granuloma \_\_\_\_\_  
\_\_\_\_\_
14. Root resorption \_\_\_\_\_  
\_\_\_\_\_
15. Secondary dentin \_\_\_\_\_  
\_\_\_\_\_

## II. Comprehension Exercise

1. Explain why vital and nonvital pulp can appear the same on a radiograph.
2. List the causative factors of pulpal necrosis that can be seen on radiographs.
3. List three causes for a change in the normal size and shape of the pulp chamber and canals.
4. What is the first radiographic finding other than etiologic factors of periapical pathology?

5. How can you differentiate between periapical pathology and PCD (PCOD)?
6. What is secondary dentin, and what is its appearance and clinical significance?
7. What are the most common causes for the formation of secondary dentin?
8. How can you differentiate radiographically between internal and external idiopathic root resorption?
9. What tissues are affected by periapical pathology?
10. Describe the radiographic appearance of condensing osteitis. How does it differ from cementoma (PCD)?

11. Why are periapical cysts seen as radiolucencies?
12. In making a diagnosis of a necrotic pulp, why is it essential to see the apex of the tooth on the radiograph?
13. Name some possible causes of root resorption.
14. What are the radiographic signs of pulpitis?
15. Explain the progression of PCD (PCOD) and how it appears radiographically in all three stages.

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

*Column A*

- \_\_\_\_\_ 1. secondary dentin
- \_\_\_\_\_ 2. condensing osteitis
- \_\_\_\_\_ 3. calcified pulp
- \_\_\_\_\_ 4. root resorption
- \_\_\_\_\_ 5. three-stage lesion
- \_\_\_\_\_ 6. internal resorption
- \_\_\_\_\_ 7. pulp denticle
- \_\_\_\_\_ 8. periapical pathology
- \_\_\_\_\_ 9. fistulous tract
- \_\_\_\_\_ 10. external root resorption
- \_\_\_\_\_ 11. high pulp horns
- \_\_\_\_\_ 12. residual cyst
- \_\_\_\_\_ 13. periapical cyst
- \_\_\_\_\_ 14. pulpitis
- \_\_\_\_\_ 15. decrease in pulp size

*Column B*

- a. seen in young patients
- b. pulpal tissue resorbs the dentin
- c. vertical bone loss
- d. exudate spills from the pulp
- e. difficult to see on radiographs
- f. pulp stone
- g. present in edentulous areas
- h. no radiographic sign
- i. PCD (PCOD)
- j. dentinogenesis imperfecta
- k. no treatment indicated
- l. radiolucent
- m. idiopathic
- n. hard to distinguish
- o. agenesis
- p. may be asymptomatic
- q. chronic infection

## IV. Illustrations

1. (Figure 22-1) There is pain and tenderness in the mucobuccal fold in the area of the extracted central incisor. All teeth test vital. What is your diagnosis?

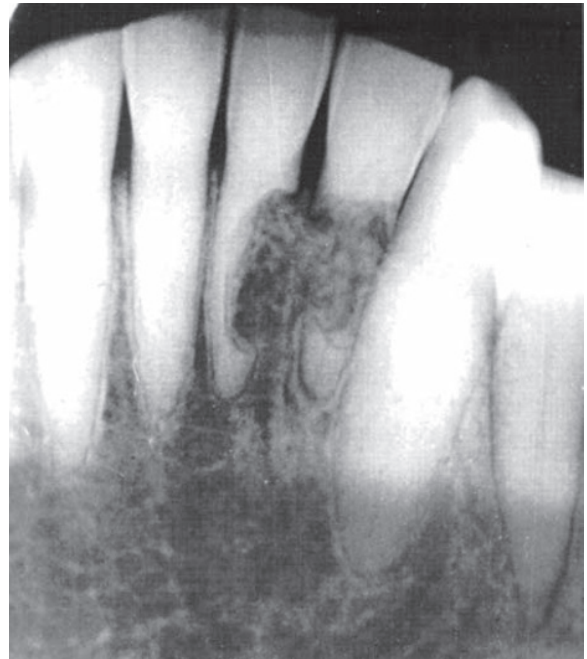


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2. (Figure 22-2) This radiograph was taken of an asymptomatic new patient. What is your diagnosis for the condition seen here?

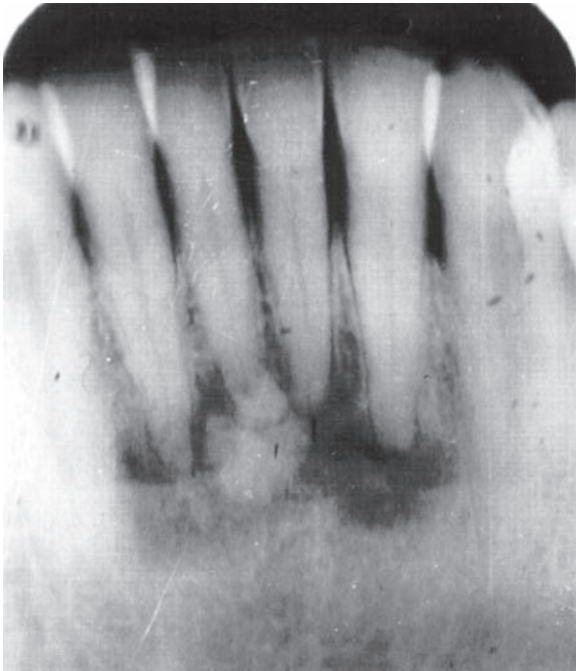


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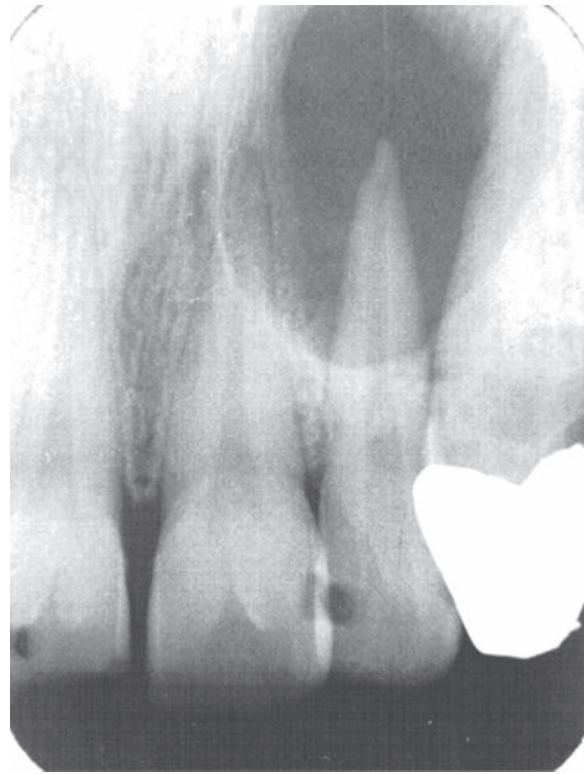
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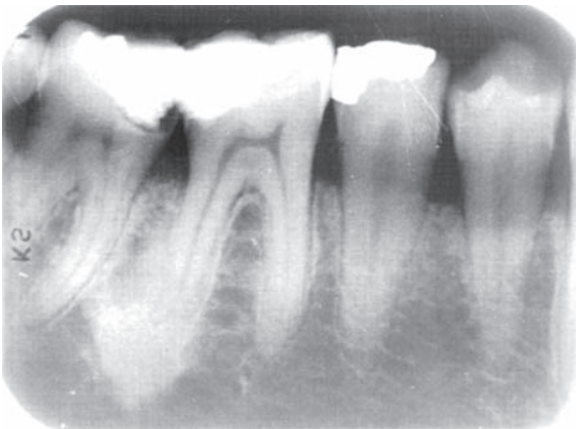
3. (Figure 22-3) What is your diagnosis for this condition seen in this 49-year-old woman where all teeth test vital?



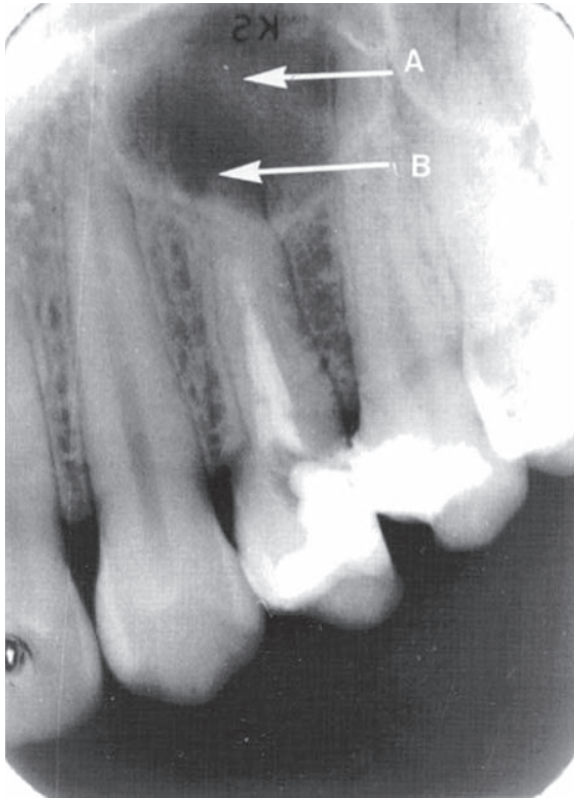
5. (Figure 22-5) Pain and swelling are associated with the lateral incisor. What is your diagnosis?



4. (Figure 22-4) The lower first molar is nonvital. What is your diagnosis of the radiopacity on the distal root?



6. (Figure 22-6) Identify the radiolucent areas A and B. Note the incomplete endodontic filling in the first premolar.



- a. \_\_\_\_\_  
b. \_\_\_\_\_

## V. Complete These Statements

1. A tooth with a periapical cyst will always pulp test \_\_\_\_\_.
2. PCD (PCOD) has \_\_\_\_\_ radiographic stages.
3. \_\_\_\_\_ periapical lesions are always considered in a diagnosis of an intrabony lesion.
4. An apical radiopacity in a nonvital tooth is called \_\_\_\_\_.
5. Marked toothbrush abrasion will cause the pulp to \_\_\_\_\_.
6. \_\_\_\_\_ appear as well-defined radiopacities within the pulp chamber.
7. Radiographically it is difficult, if not impossible, to differentiate between the apical lesions \_\_\_\_\_ and \_\_\_\_\_ on a nonvital tooth.
8. A chronic periapical abscess may cause \_\_\_\_\_.
9. The \_\_\_\_\_ abscess may cause root resorption and a more diffuse radiolucency.
10. To differentiate between a first-stage PCD (PCOD) and periapical pathology one should \_\_\_\_\_.
11. To differentiate between a third-stage PCD (PCOD) and condensing osteitis one should \_\_\_\_\_.
12. The formation of \_\_\_\_\_ may accompany the developmental disturbance known as dentinogenesis imperfecta.
13. In longstanding internal root resorption the prognosis for the tooth is usually \_\_\_\_\_.
14. Periapical pathology is not seen on \_\_\_\_\_ radiographs.
15. The most often seen pathologic condition after caries and periodontal disease seen radiographically is \_\_\_\_\_ and subsequent \_\_\_\_\_ lesions.

## VI. Multiple Choice

Select the best answer.

1. Which of the following appears radiopaque on a radiograph?
  - a. periapical cyst
  - b. periapical granuloma
  - c. condensing osteitis
  - d. periodontal abscess
  - e. none of the above
2. The best radiographic projection for detection of periapical pathology is
  - a. bitewing
  - b. periapical
  - c. panoramic
  - d. occlusal
  - e. all of the above
3. If a granuloma or cyst that surrounds the apex of a nonvital tooth is not curetted out at the time of extraction it may
  - a. grow
  - b. destroy bone
  - c. move and possibly devitalize teeth
  - d. all of the above
  - e. none of the above
4. The radiographic appearance of periapical cemental dysplasia (periapical cemental osseous dysplasia) will be
  - a. radiopaque
  - b. radiolucent
  - c. mixed
  - d. all of the above
  - e. none of the above
5. An apical radiolucency in a nonvital, asymptomatic tooth is most likely diagnosed as
  - a. external root resorption
  - b. periapical granuloma
  - c. root resorption
  - d. condensing osteitis
  - e. none of the above
6. Root resorption can be caused by
  - a. rapid excessive orthodontic pressure
  - b. chronic periapical infection
  - c. chronic periodontal infection
  - d. all of the above
  - e. none of the above
7. The pulp chamber and canals of teeth in older patients tend to be
  - a. inflamed
  - b. necrotic
  - c. calcified
  - d. enlarged
  - e. none of the above
8. A normal radiographic anatomic landmark that can be misdiagnosed as periapical pathology is the
  - a. mandibular foramen
  - b. mental foramen
  - c. mental ridge
  - d. mandibular ridge
  - e. none of the above
9. If a maxillary central incisor tests vital, the most likely interpretation for a radiolucency near its apex is
  - a. periapical pathology
  - b. maxillary sinus
  - c. nasal cavity
  - d. nasopalatine foramen
  - e. none of the above
10. Condensing osteitis should be treated with
  - a. extraction
  - b. root canal therapy
  - c. no treatment
  - d. both a and b are possible treatment options
  - e. none of the above



11. The density of secondary dentin when compared radiographically to normal dentin is
- a. more dense
  - b. less dense
  - c. more opaque
  - d. the same
  - e. none of the above

12. Large high pulp horns are more frequently seen in
- a. young patients
  - b. teeth with extensive caries
  - c. teeth with deep restorations
  - d. abraded teeth
  - e. none of the above

13. Which of the following will appear radiopaque on a processed radiograph?
- a. condensing osteitis
  - b. sclerotic bone
  - c. hypercementosis
  - d. all of the above
  - e. none of the above

14. Radiographically pulp capping materials will appear
- a. radiolucent
  - b. metallic
  - c. not at all
  - d. radiopaque
  - e. none of the above

15. The process occurring when the cells of the periodontal ligament resorb the cementum and dentin of the root is known as
- a. internal resorption
  - b. periapical cemental dysplasia
  - c. external resorption
  - d. none of the above
  - e. all of the above

---

## VII. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

1. Most pulpal and periapical lesions are not the sequelae of caries, trauma, intrabony lesions, or advanced periodontal disease. **T/F**
2. The radiographic densities of pulp chambers and canals differ because of size, position in the tooth and radiographic angulation, but not because of vitality. **T/F**
3. There are no radiographic signs of pulpitis in the pulp chamber. **T/F**
4. It is possible to differentiate between a peripical granuloma and a periapical cyst. **T/F**
5. Periapical condensing osteitis is a radiolucent (RL) periapical pathologic condition and should be treated with either root canal therapy or extraction. **T/F**

# Developmental Disturbances of Teeth and Bone

## Educational Objectives

*After reading Chapter 23 of the textbook and completing this exercise, the student will*

1. Understand the formation and radiographic appearance of developmental lesions of teeth and bone.
2. Recognize developmental lesions of teeth and bone and know which radiographic projections are necessary to formulate a diagnosis.

## I. Definitions

Define/explain the following terms.

1. Amelogenesis imperfecta \_\_\_\_\_  
\_\_\_\_\_
2. Cleft palate \_\_\_\_\_  
\_\_\_\_\_
3. Concrescence \_\_\_\_\_  
\_\_\_\_\_
4. Dens invaginatus \_\_\_\_\_  
\_\_\_\_\_
5. Dentigerous cyst \_\_\_\_\_  
\_\_\_\_\_
6. Dentinogenesis imperfecta \_\_\_\_\_  
\_\_\_\_\_
7. Dilaceration \_\_\_\_\_  
\_\_\_\_\_
8. Enamel pearl \_\_\_\_\_  
\_\_\_\_\_
9. Eruption time \_\_\_\_\_  
\_\_\_\_\_

10. Fusion \_\_\_\_\_  
\_\_\_\_\_
11. Gemination \_\_\_\_\_  
\_\_\_\_\_
12. Hypercementosis \_\_\_\_\_  
\_\_\_\_\_
13. Hyperdontia \_\_\_\_\_  
\_\_\_\_\_
14. Hypodontia \_\_\_\_\_  
\_\_\_\_\_
15. Impacted tooth \_\_\_\_\_  
\_\_\_\_\_

## II. Comprehension Exercise

1. What is a supernumerary tooth and what is its clinical importance?
  
  
  
  
  
  
  
  
  
  
2. What is the clinical significance of radiographically detecting hypodontia in the secondary dentition?
  
  
  
  
  
  
  
  
  
  
3. What is the cause of a cleft and where could a cleft occur?

4. Distinguish radiographically between amelogenesis imperfecta and dentinogenesis imperfecta.
5. How can a radiographic examination help in the evaluation of tooth development and eruption?
6. What is a primordial cyst?
7. Describe what teeth would be seen on a mandibular premolar periapical film of a 10-year-old patient.
8. How does an impacted tooth appear radiographically?
9. What are fissural cysts and where are they found?

10. What are the radiographic distinctions between concrescence and fusion?
11. Describe the radiographic appearance of a dilacerated tooth. What is its clinical significance?
12. What are enamelomas and how are they usually discovered?
13. How does a cleft appear radiographically?
14. What is the best radiographic projection to visualize a median palatal cyst?
15. What is dens invaginatus and how is it formed?

16. Distinguish between a nasopalatine cyst and a globulomaxillary cyst in regard to radiographic appearance and location.
17. Describe the radiographic appearance of a dentigerous cyst.
18. Describe the appearance of a developing tooth follicle.
19. Why is it important to localize impacted teeth in three planes?
20. What are the best radiographic projections to visualize a nasopalatine cyst?

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

*Column A*

- \_\_\_\_\_ 1. enamel pearl
- \_\_\_\_\_ 2. fusion
- \_\_\_\_\_ 3. concrescence
- \_\_\_\_\_ 4. dilaceration
- \_\_\_\_\_ 5. nasopalatine cyst
- \_\_\_\_\_ 6. amelogenesis imperfecta
- \_\_\_\_\_ 7. hyperdontia
- \_\_\_\_\_ 8. mixed dentition
- \_\_\_\_\_ 9. taurodontia
- \_\_\_\_\_ 10. hypodontia
- \_\_\_\_\_ 11. cleidocranial dysostosis
- \_\_\_\_\_ 12. dentigerous cyst
- \_\_\_\_\_ 13. hypercementosis
- \_\_\_\_\_ 14. cleft palate
- \_\_\_\_\_ 15. dens invaginatus

*Column B*

- a. normal crown, short roots
- b. failure of processes to fuse
- c. lack of enamel
- d. nonodontogenic
- e. supernumerary teeth
- f. agenesis
- g. enameloma
- h. club-shaped root
- i. S-shaped root
- j. one crown, two canals
- k. delayed eruption
- l. joined by cementum
- m. midline location
- n. 6 to 12 years old
- o. two crowns, one canal
- p. nonvital
- q. tooth bud's cystic degeneration
- r. dens in dente

## IV. Illustrations

Identify the following tooth conditions.

1. (Figure 23-1).

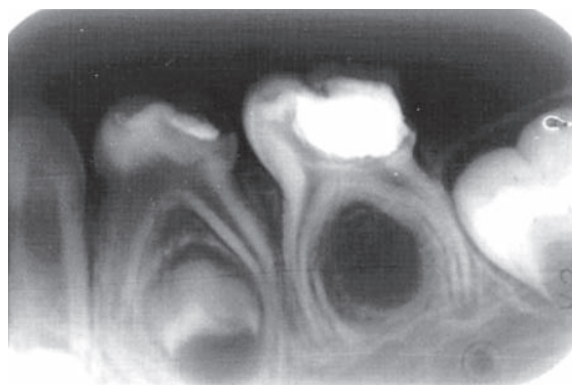


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2 (Figure 23-2).



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3. (Figure 23-3).



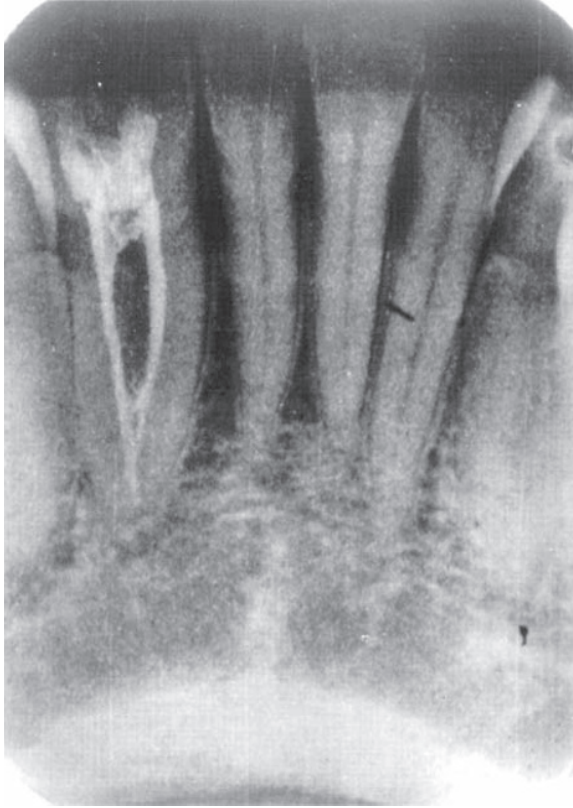
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4. (Figure 23-4).

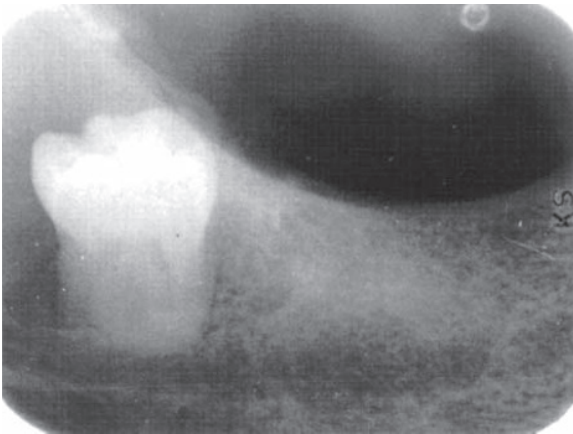


\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

5. (Figure 23-5).



\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## V. Complete These Statements

1. An impacted tooth surrounded by a large radiolucent area is the description of a \_\_\_\_\_.
2. The condition in which adjoining teeth are connected by cementum is called \_\_\_\_\_.
3. Periapical radiographs of patients younger than 12 years reveal some evidence of a \_\_\_\_\_.
4. In Paget's disease of bone, very often the roots of the teeth show \_\_\_\_\_.
5. The presence of supernumerary teeth is also known as \_\_\_\_\_.
6. A large symptomatic radiolucent lesion near the apices of vital maxillary incisors is very likely a \_\_\_\_\_.
7. A buildup of cementum on the root of the tooth is commonly known as \_\_\_\_\_.
8. The point of invagination in dens invaginatus is usually the \_\_\_\_\_ of the tooth.
9. The term that describes the condition of congenital absence of many teeth is \_\_\_\_\_.
10. Dentinogenesis and amelogenesis imperfecta are both \_\_\_\_\_ disturbances that affect both the primary and secondary dentitions.

## VI. Multiple Choice

Select the best answer.

1. All teeth test vital in an 11-year-old patient. A radiolucency at the apices of a permanent mandibular second molar that has no caries or restorations is probably
  - a. a granuloma
  - b. a residual cyst
  - c. a periapical abscess
  - d. incomplete root formation
  - e. none of the above
2. Conditions affecting the eruption pattern that can only be seen by radiographic examination include
  - a. anodontia
  - b. tumors
  - c. supernumerary teeth
  - d. all of the above
  - e. none of the above
3. In dentinogenesis imperfecta the teeth appear radiographically
  - a. with elongated roots
  - b. with premature calcification of the pulp chamber
  - c. with no enamel
  - d. with no dentin
  - e. none of the above
4. Most impacted teeth are not visible on
  - a. radiographic examination
  - b. periapical radiographs
  - c. panoramic radiographs
  - d. clinical examination
  - e. none of the above
5. A fused maxillary central incisor will appear radiographically to have
  - a. one pulp chamber, one pulp canal
  - b. no pulp chamber, two pulp canals
  - c. two pulp chambers, two pulp canals
  - d. one pulp chamber, two pulp canals
  - e. none of the above
6. Which of the following is not a common supernumerary tooth?
  - a. mesiodens
  - b. distodens
  - c. paramolar
  - d. maxillary premolar
  - e. none of the above
7. A globulomaxillary cyst will always appear radiographically
  - a. apical to the central incisors
  - b. distal to the maxillary cuspid
  - c. in the midline of the palate
  - d. between the maxillary lateral and canine
  - e. none of the above
8. The radiographic detection of an enamel pearl on a tooth indicates
  - a. nothing clinically
  - b. that the tooth may be nonvital
  - c. that the tooth should be extracted
  - d. that the tooth is a poor abutment tooth
  - e. none of the above
9. Teeth with hypercementosis are usually
  - a. vital
  - b. nonvital
  - c. scheduled for extraction
  - d. replaced with implants
  - e. not treated
10. The best diagnosis for a tooth that appears radiographically to have enamel-like material in the pulp chamber is
  - a. amelogenesis imperfecta
  - b. fusion
  - c. dens invaginatus
  - d. concrescence
  - e. none of the above
11. The normal range of eruption time for the permanent dentition is
  - a.  $\pm 9$  months
  - b.  $\pm 2$  months
  - c. +1 year
  - d.  $\pm 1$  month
  - e. none of the above

12. A mesiodens is always
  - a. nonvital
  - b. found distal to the terminal molar
  - c. to be extracted
  - d. found in the midline
  - e. none of the above
13. A dilacerated root could present a problem when
  - a. the tooth should be extracted
  - b. the tooth needs root canal therapy
  - c. the tooth is endodontically involved
  - d. all of the above are possible answers
  - e. none of the above
14. A dentigerous cyst should
  - a. be surgically removed
  - b. be observed every 6 months
  - c. be radiographed every year
  - d. be radiographed every 2 years
  - e. none of the above
15. The best radiographic projection for the detection of an impacted mandibular third molar is
  - a. right-angle occlusal
  - b. bitewing
  - c. panoramic
  - d. molar periapical
  - e. none of the above

## VII. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

1. The developing tooth can be seen at all stages on radiographs. **T/F**
2. If root formation is not complete, a radiolucent (RL) area may appear around the root tip. **T/F**
3. Supernumerary teeth, and their relative position to other teeth, are not easily detectable even on the proper radiographs. **T/F**
4. Enamel pearls (enameloma) are small, spherical-shaped pieces of enamel attached to the crowns of teeth. **T/F**
5. Fissural cysts are always found in predictable anatomic locations because they develop along embryonic suture lines. **T/F**

# Bone and Other Lesions

## Educational Objectives

*After reading Chapter 24 of the textbook and completing this exercise, the student will*

1. Recognize bone lesions and differentiate their appearance from normal.
2. Understand which radiographic projections are needed to make a complete radiographic diagnosis of bone lesions.

## I. Definitions

Define/explain the following terms.

1. Benign tumor \_\_\_\_\_  
\_\_\_\_\_
2. Buccal cortex of bone \_\_\_\_\_  
\_\_\_\_\_
3. Cyst \_\_\_\_\_  
\_\_\_\_\_
4. Extent of the lesion \_\_\_\_\_  
\_\_\_\_\_
5. Extraction socket \_\_\_\_\_  
\_\_\_\_\_
6. Foreign body \_\_\_\_\_  
\_\_\_\_\_
7. Fracture \_\_\_\_\_  
\_\_\_\_\_
8. Malignant tumor \_\_\_\_\_  
\_\_\_\_\_
9. Metabolic lesion \_\_\_\_\_  
\_\_\_\_\_

10. Mixed lesion \_\_\_\_\_  
\_\_\_\_\_
11. Radiolucent \_\_\_\_\_  
\_\_\_\_\_
12. Radiopaque \_\_\_\_\_  
\_\_\_\_\_
13. Sialolith \_\_\_\_\_  
\_\_\_\_\_
14. Trabecular pattern of bone \_\_\_\_\_  
\_\_\_\_\_
15. Tumor \_\_\_\_\_  
\_\_\_\_\_

## II. Comprehension Exercise

1. Name three causes of root resorption.
2. Why is it difficult to identify a root fracture radiographically?
3. How does a bone fracture appear radiographically? Why?
4. How do sialoliths appear radiographically? How are they best radiographed?

5. In radiographing tumors, what is the importance of the right-angle occlusal projection?
6. In radiographing tumors and cysts, what is the advantage of using a panoramic projection?
7. How long can an extraction site be radiographically evident and why?
8. What is a hyperostotic line? What is its diagnostic significance?
9. When are foreign bodies most apparent and which are easiest to identify and most commonly occurring?
10. Describe the radiographic appearance of a retained root tip. How can it be differentiated from a dense area of bone?

11. How do metabolic bone lesions manifest themselves? Give three examples of diseases that would manifest in this manner.
12. Would an osteoma appear radiopaque or radiolucent? Why?
13. What is the most obvious radiographic appearance of a malignant lesion in comparison with a benign lesion?
14. Would a cyst appear radiopaque or radiolucent? Why?
15. What two extraoral projections should one expose in a suspected tumor of the maxillary sinus?

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

#### Column A

- \_\_\_\_\_ 1. odontoma
- \_\_\_\_\_ 2. malignant
- \_\_\_\_\_ 3. metallic fragment
- \_\_\_\_\_ 4. benign tumor
- \_\_\_\_\_ 5. extraction sockets
- \_\_\_\_\_ 6. fracture
- \_\_\_\_\_ 7. extent of the lesion
- \_\_\_\_\_ 8. parotid gland
- \_\_\_\_\_ 9. retained root tips
- \_\_\_\_\_ 10. dentigerous cyst
- \_\_\_\_\_ 11. mixed lesion
- \_\_\_\_\_ 12. cysts
- \_\_\_\_\_ 13. Paget's disease
- \_\_\_\_\_ 14. ameloblastoma
- \_\_\_\_\_ 15. sialolith

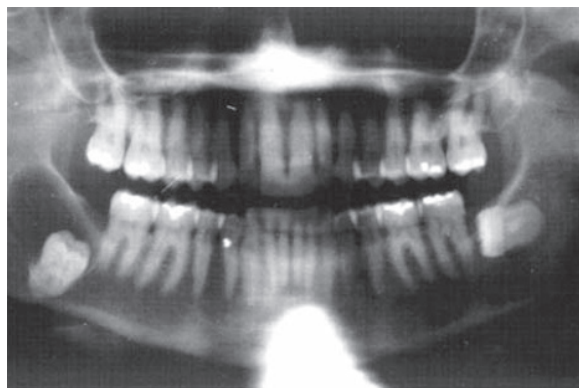
#### Column B

- a. radiolucent
- b. lateral oblique projection
- c. enlarged marrow spaces
- d. cottonwool effect
- e. variety of densities
- f. mandibular third molar region
- g. well-defined lesions
- h. density of tooth structure
- i. poorly defined borders
- j. resembles tooth structure
- k. radiopaque
- l. associated with impacted teeth
- m. see the entire lesion
- n. right-angle occlusal film
- o. nonvital teeth
- p. evident for up to 6 months
- q. radiolucent line

### IV. Illustrations

Identify the following tooth conditions.

1. (Figure 24-1) What is your diagnosis for the conditions seen on this panoramic radiograph?




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2. (Figure 24-2) What is your diagnosis for the tumor shown here?




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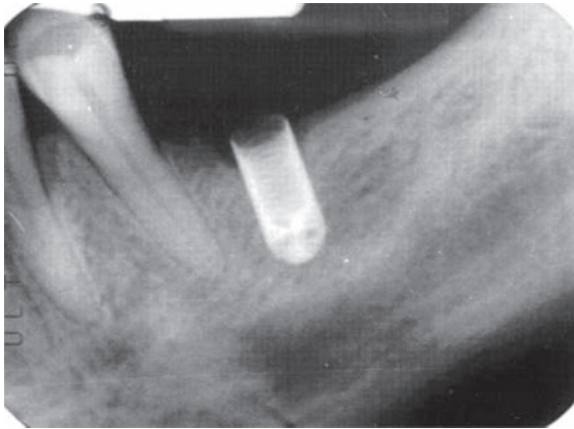
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3. (Figure 24-3) What is your interpretation of the radiopaque structure seen here?




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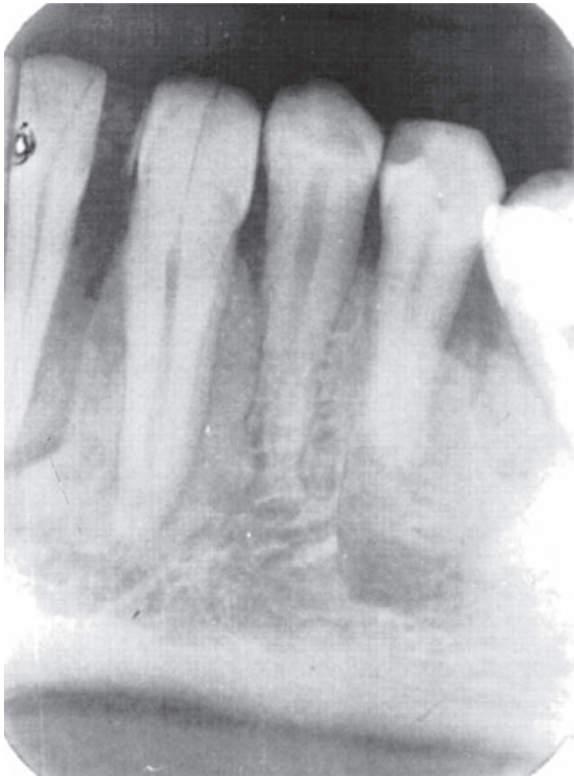


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4. (Figure 24-4) This patient fell off a bicycle, sustaining lacerations to the lip and cheek. The cuspid is extremely painful to touch. What is your diagnosis?




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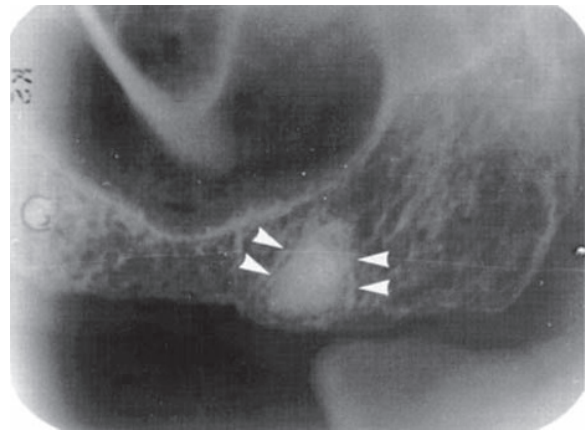


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5. (Figure 24-5) Give two possible diagnoses for the radiopaque area the arrow is pointing to in this illustration.




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## V. Complete These Statements

1. A sialolith of the submandibular duct can best be seen on a \_\_\_\_\_ radiographic projection.
2. Salivary stones are a common cause of \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
3. An intraosseous tumor that has the density of tooth components is an \_\_\_\_\_.
4. Three projections for viewing a sialolith in the parotid gland are a \_\_\_\_\_, \_\_\_\_\_, and a \_\_\_\_\_ placed in the mucobuccal fold.

5. Intraosseous malignant tumors will usually \_\_\_\_\_ the buccal cortex of the jawbones.
6. Retained root tips have the density of \_\_\_\_\_, making them difficult to differentiate from dense areas of bone.
7. An example of a radiopaque benign tumor is a \_\_\_\_\_.
8. Only those foreign bodies that are \_\_\_\_\_ can be seen radiographically.
9. The extraoral projection that is used to visualize the cottonwool appearance in Paget's disease is the \_\_\_\_\_.
10. Tooth and root fractures can lead to pulp damage and ensuing \_\_\_\_\_ conditions.
11. The radiopaque line seen on radiographs surrounding a slow-growing tumor is called the \_\_\_\_\_.
12. In a suspected fracture of the mandible the two radiographic projections that should be taken are the \_\_\_\_\_ and the \_\_\_\_\_.
13. An extraction socket is usually filled in with bone in about \_\_\_\_\_.
14. A tumor that tends to move teeth is usually \_\_\_\_\_.
15. An unerupted tooth surrounded by a large radiolucent area is usually the description of a \_\_\_\_\_.

## VI. Multiple Choice

Select the best answer.

1. Which of the following pathologic conditions appears radiopaque on intraoral radiographs?
  - a. a granuloma
  - b. a periapical cyst
  - c. an osteoma
  - d. a connective tissue tumor
  - e. none of the above
2. Tumors can appear
  - a. radiolucent
  - b. radiopaque
  - c. mixed
  - d. any of the above are possible
  - e. a and b only
3. The buccal and lingual cortex surrounding a tumor of the mandible can best be seen on a
  - a. panoramic radiograph
  - b. topographic occlusal film
  - c. lateral oblique projection
  - d. right-angle occlusal projection
  - e. none of the above
4. The radiographic differentiation between a retained root tip and a dense area of bone often can be done by identifying
  - a. enamel
  - b. cementum
  - c. dentin
  - d. a pulp canal
  - e. none of the above
5. Metabolic radiographic bone lesions can be seen with
  - a. Paget's disease
  - b. types of anemia
  - c. hyperparathyroidism
  - d. any of the above is possible
  - e. none of the above

6. The trabecular pattern of bone in a suspected metabolic lesion can best be interpreted with
  - a. bitewing film
  - b. periapical film
  - c. panoramic film
  - d. extraoral film
  - e. none of the above
7. In making a radiographic diagnosis of a suspected tumor
  - a. all the borders of the lesion must be seen
  - b. the distal border must be seen
  - c. the buccal cortex must be seen
  - d. the center of the lesion must be seen
  - e. none of the above
8. Extraction sockets are initially seen as
  - a. radiolucent areas
  - b. radiopaque areas
  - c. mixed areas
  - d. any of the above are possible
  - e. a and b only
9. Fractures of the mandible or maxilla may appear radiographically as
  - a. a radiopaque line
  - b. a radiolucent line
  - c. a radiolucent area
  - d. a mixed area
  - e. none of the above
10. A sialolith in the parotid gland can be seen in a
  - a. lateral oblique projection
  - b. posteroanterior projection
  - c. soft tissue film placed in the mucobuccal fold
  - d. CT scan
  - e. all of the above
11. When radiographed, all suspected tumors must be viewed
  - a. buccally
  - b. lingually
  - c. occlusally
  - d. in all three planes
  - e. none of the above
12. On a radiograph an amalgam fragment in an extraction socket will appear
  - a. radiopaque
  - b. not at all
  - c. radiolucent
  - d. part radiolucent, part radiopaque
  - e. none of the above
13. A common cause of dry mouth, swelling, and pain under the tongue, especially after eating, is a(n)
  - a. odontoma
  - b. periapical cyst
  - c. sialolith
  - d. periapical abscess
  - e. none of the above
14. Which of the following projections will be diagnostic for the buccal and lingual cortex of the mandible?
  - a. panoramic
  - b. periapical
  - c. lateral oblique
  - d. posterior anterior
  - e. none of the above
15. The best radiograph for viewing a sialolith in the submandibular gland is
  - a. a right-angle mandibular occlusal projection
  - b. a topographic mandibular occlusal projection
  - c. a topographic maxillary occlusal projection
  - d. a right-angle maxillary occlusal projection
  - e. none of the above

## VII. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

1. Malignancies tend to have poorly defined radiographic borders and destroy normal anatomic structures. **T/F**
2. Many metabolic conditions manifest themselves with changes of the trabecular pattern and lamina dura of bone in the mandible and maxilla. **T/F**
3. Fractures of teeth, especially anterior teeth, are very uncommon. **T/F**
4. Retained root tips do not have the density of tooth structure and are easily distinguished from dense areas of bone. **T/F**
5. Stones in the parotid gland can best be seen on mandibular occlusal film. **T/F**

## Educational Objectives

*After reading Chapter 25 of the textbook and completing this exercise, the student will*

1. Understand the laws and regulations that govern the use of radiation in dentistry.

### I. Definitions

Define/explain the following terms.

1. Confidentiality \_\_\_\_\_  
\_\_\_\_\_
2. Direct supervision \_\_\_\_\_  
\_\_\_\_\_
3. General supervision \_\_\_\_\_  
\_\_\_\_\_
4. Informed consent \_\_\_\_\_  
\_\_\_\_\_
5. Liability \_\_\_\_\_  
\_\_\_\_\_
6. Licensure \_\_\_\_\_  
\_\_\_\_\_
7. Radiation inspections \_\_\_\_\_  
\_\_\_\_\_
8. Respondeat superior \_\_\_\_\_  
\_\_\_\_\_
9. Risk management \_\_\_\_\_  
\_\_\_\_\_
10. Statute of limitations \_\_\_\_\_  
\_\_\_\_\_

## II. Comprehension Exercise

1. Is it acceptable for the insurance company to request preoperative and postoperative radiographs on a patient? Explain.
2. How long should dental radiographs be kept for a patient after he or she has ceased being a patient in the office?
3. How long does an adult patient have to file a lawsuit after the injury is committed? How long if the patient is a child?
4. Who owns the radiographic series—the patient or the dentist? What rights to the radiographs does the patient have? Explain.
5. What confidentiality issues apply to dental radiographs as a permanent part of a patient's records?
6. Why is it vitally important to keep accurate patient records?

7. What is risk management and who should participate in the program in a dental office?
8. Why is it important for the dental support staff to review the patient's health history before taking radiographs?
9. What is the difference between direct and general supervision in a dental office and how are these principles applied to dental radiography?
10. In what three major categories are the legal considerations regarding the use of ionizing radiation in dentistry included?

### III. Matching

Match the items in *Column A* with the appropriate items in *Column B*.

#### *Column A*

- \_\_\_\_\_ 1. risk management
- \_\_\_\_\_ 2. direct supervision
- \_\_\_\_\_ 3. respondeat superior
- \_\_\_\_\_ 4. negligent
- \_\_\_\_\_ 5. general supervision
- \_\_\_\_\_ 6. full disclosure
- \_\_\_\_\_ 7. informed consent
- \_\_\_\_\_ 8. res gestae
- \_\_\_\_\_ 9. standard of care
- \_\_\_\_\_ 10. HIPAA

#### *Column B*

- a. captain of the ship principle
- b. admissions against interest
- c. permission granted
- d. dentist is physically present
- e. at fault
- f. confidentiality
- g. personal radiation exposure
- h. ownership of radiographs
- i. dentist can be reached
- j. reduce likelihood of suits
- k. informing the patient
- l. statute of limitations
- m. usually performed procedures

### IV. Complete These Statements

1. The \_\_\_\_\_ is the guardian of the dental radiographs.
2. The three most important parts of a defense in a malpractice suit are the "\_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_."
3. The statute of limitation for an adult patient to file suit is \_\_\_\_\_ years and for a child it is approximately \_\_\_\_\_ years after he or she has reached the age of 21.
4. The insurance company cannot request \_\_\_\_\_ radiographs because their use is considered administrative.
5. All radiographic equipment manufactured or sold after \_\_\_\_\_ must meet federal regulations.
6. Many states require biannual or triennial \_\_\_\_\_ of the x-ray machines in the dental office.
7. \_\_\_\_\_ is the policies and procedures designed to reduce the likelihood of suits for malpractice against dentists.
8. \_\_\_\_\_, professionally and legally, rests with the dentist and not the dental hygienist or the dental assistant.
9. \_\_\_\_\_ means that the dentist is physically present in the office when the radiographs are being taken by the dental hygienist or assistant.
10. Radiographs of poor \_\_\_\_\_ can weaken the defense in a lawsuit for which they are being used as evidence.



## V. Multiple Choice

Select the best answer.

1. Ownership of the radiographs rests with the
  - a. dentist
  - b. hygienist
  - c. patient
  - d. assistant
  - e. none of the above
2. Insurance carriers can request
  - a. postoperative radiographs
  - b. preoperative radiographs
  - c. any radiograph taken on the patient
  - d. only the patient's radiographs that were taken during the last year
  - e. none of the above
3. The dental office supportive staff can participate in obtaining informed consent from the patient, which entails
  - a. formulating a diagnosis
  - b. formulating a prognosis
  - c. explaining the nature and purpose of the procedure to the patient
  - d. holding back any information about the procedures to the patient
  - e. none of the above
4. The doctrine of respondeat superior is also known as the
  - a. res gestae
  - b. "captain of the ship" principle
  - c. risk management theory
  - d. statute of limitations
  - e. none of the above
5. The legal considerations with which dental assistants and hygienists should be concerned regarding the dental use of ionizing radiation are
  - a. regulations regarding x-ray equipment
  - b. risk management
  - c. licensure and periodic inspection for users of x-ray equipment
  - d. a and b only
  - e. all of the above
6. Statements made by anyone at the time of an alleged negligent act are
  - a. not admissible as evidence
  - b. only admissible as evidence if recorded
  - c. only admissible as evidence if repeated
  - d. admissible as evidence
  - e. none of the above
7. Dental radiographs are considered a part of the patient's dental record and are therefore considered
  - a. to be illegal documents
  - b. to be negligible documents
  - c. to be liable documents
  - d. to be legal documents
  - e. none of the above
8. If the radiographic evidence presented to the court is illegible, the court may
  - a. request the original radiographs
  - b. not accept the radiographs as evidence
  - c. allow the case to be affected by the lack of evidence
  - d. a and b only
  - e. all of the above

9. Dental procedures should not be performed without current and diagnostic radiographs because their use is now
- a. the only dental records needed for diagnosis
  - b. the standard of care
  - c. the only dental record needed for insurance purposes
  - d. the only dental record needed to formulate a prognosis
  - e. none of the above
10. The patient's records are
- a. discussed freely among dental professionals
  - b. discussed only with the dental hygienist
  - c. discussed only with the dentist
  - d. confidential
  - e. none of the above

## VI. True/False

Select whether each statement is true (**T**) or false (**F**). Circle the correct answer.

1. All dental x-ray machines either manufactured or sold in the United States after 1974 must meet the federal government's performance standards. **T/F**
2. The dental professional should be knowledgeable about the rules and regulations of the state in which he or she is exposing radiographs. **T/F**
3. Liability, both professionally and legally, rests with all members of the dental staff. **T/F**
4. Dental radiographs are considered part of the patient's dental record but are not considered legal documents. **T/F**
5. The contents or findings in the patient's records are strictly confidential and should never be discussed or shown to anyone outside the dental facility. **T/F**